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POWER

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PUMPS & COMPRESSORS
STEAM SERVICES
ELECTRICITY & ELEVATORS
INSTRUMENTS & CONTROL
PIPING SYSTEMS
MECHANICAL TRANSMISSION
POWER MISCELLANY

MAY, 1938

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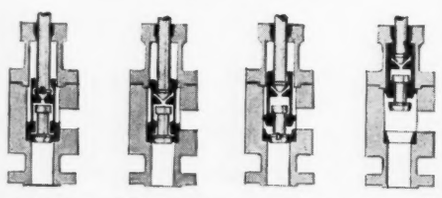
The Cochrane 2-in-1 Feature

Demonstrating Sequence of Operation



1 Closed position with sealing and check disks against seat and by-pass valve "B" closed.

2 First movement. Stem raised to unseat by-pass valve with full pressure against main valve disk "C".

3 Further rise of stem removes sealing disk from region of wire drawing and high velocity. Check "D" still closed.

4 Position of the member parts when the valve is completely open.

PROOF

MAIN VALVE DISK
Note how original smoothness and polish are retained after three years of drop-tight service

CHECK VALVE DISK
which takes harsh treatment, due to abrasive action of discharge

VALVE SEAT
The upper seat gives drop tightness in contact with main valve disk. The lower seat takes harsh treatment in opening and closing of valves

PROOF OF COCHRANE QUALITY
Unretouched photos of valve and seat parts of Cochrane valve after 3 years service at 400 lbs. pressure. Equally true of higher pressures.

Cochrane Two-In-One Feature insures absolute drop-tightness, positive protection to valves and seats—hence practically no maintenance cost.

Cochrane Three-In-One Tandem Valve, combining a screw-down element with rotary plug valve in a single body. Forged Steel Body makes it especially adapted to hard service and high pressures.

COCHRANE CORPORATION . . . .

COCHRANE CORPORATION ★ PENNA 1920 ★

COCH

WATER SOFTENERS • DEAERATING HEATERS • DEAERATOR LO

eckhefer Container Corp. Trinity Portland Cement Co. Lang Pa
ncinnati Rubber Co. Faxton Hospital Firestone Tire & Rubber Co.
Barber

at any pressure

COCHRANE BLOW-OFF VALVES

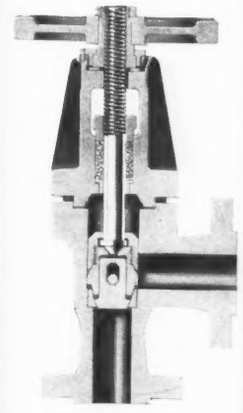
THE CONTROL of high pressure blow-off where drop-tightness *must* be maintained was successfully solved by Cochrane engineers through the incorporation of two valves in one valve element.

This ingenuity of design—plus the basic principle of tight metal-to-metal seating against hardened conical faces—prevents scoring, cutting and wire-drawing under any working pressure and temperature encountered.

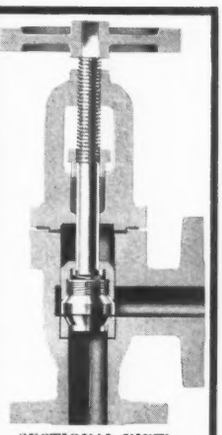
Note in the diagrammatic sketches demonstrating the sequence of operation of the 2-in-1 feature (on page opposite) that the main valve disk is never subjected to wire-drawing because it is lifted from the seat before the flow begins.

No tougher service laboratories for Blow-Off Valves exist than the high pressure plants of this nation's industrial leaders. Cochrane Valves are meeting all ranges of temperature and difficult service with hundreds of installations. Many have been in use for over 10 years at pressures as high as 1800 lbs.

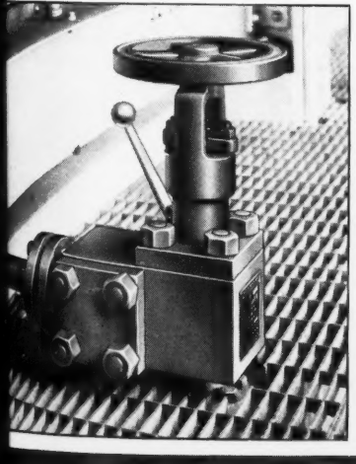
The complete line of Cochrane Blow-Off Valves includes screw-down valves and rotary plug valves combined in the same body or individually, thus assuring satisfactory service and economical operation and low maintenance on every type of process control or boiler blow-off service.

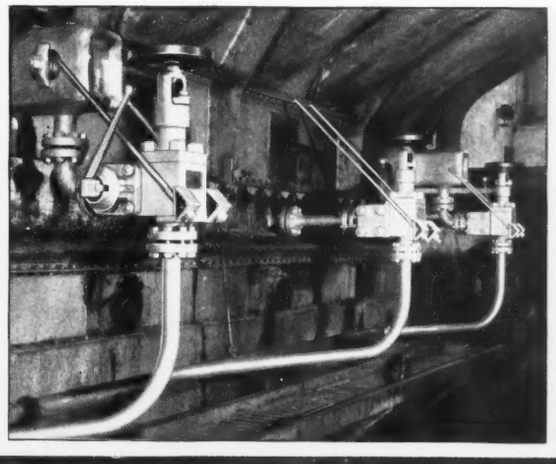


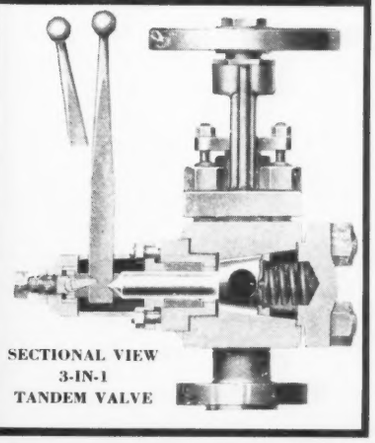
SECTIONAL VIEW
2-IN-1 VALVE



SECTIONAL VIEW
SINGLE SEAT
SCREW-DOWN VALVE







SECTIONAL VIEW
3-IN-1
TANDEM VALVE

3106 N. 17th ST., PHILADELPHIA, PA.

HRANE

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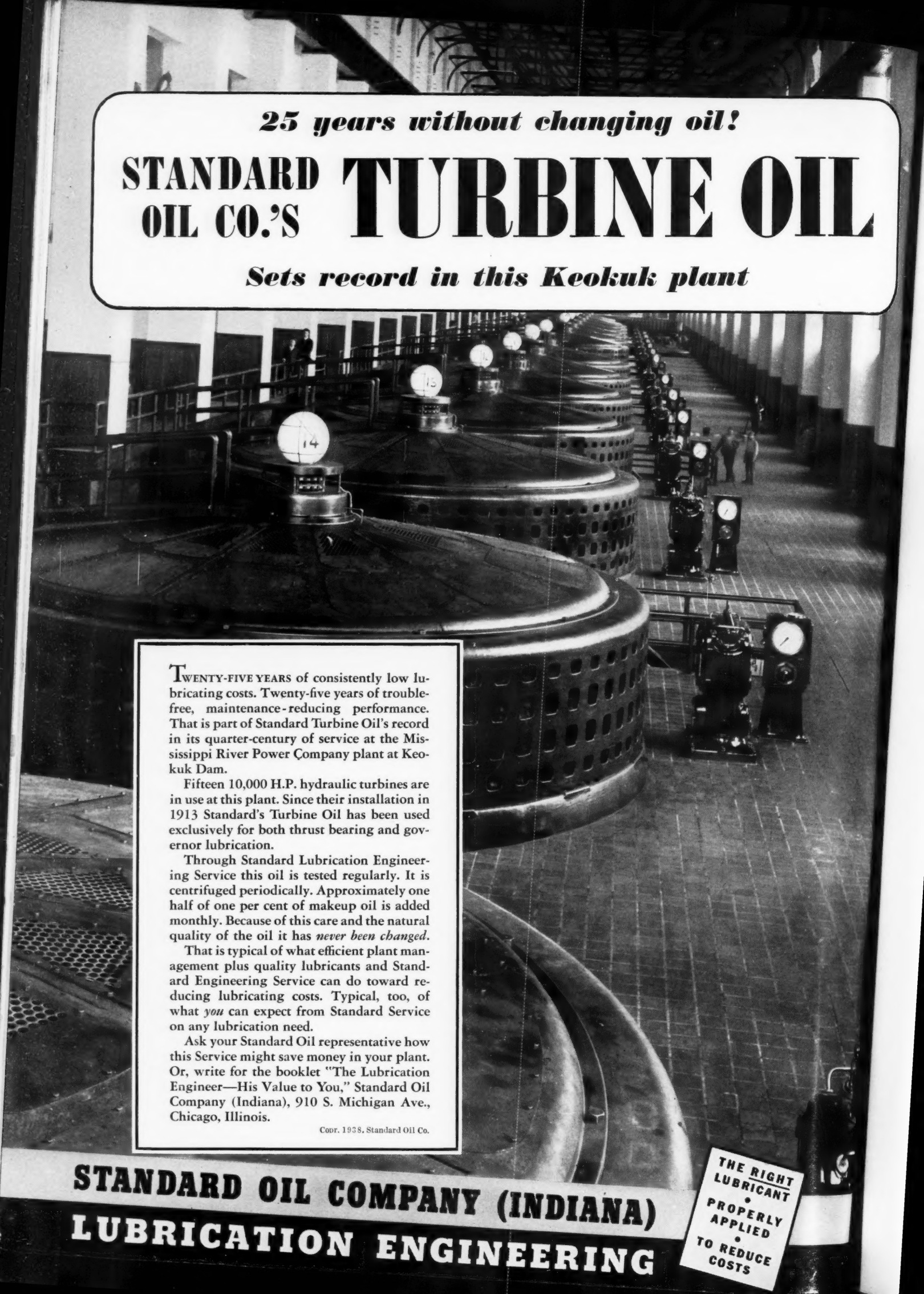
TOR LOW-OFF EQUIPMENT • FLOW METERS • STEAM SPECIALTIES



25 years without changing oil!

STANDARD OIL CO.'S TURBINE OIL

Sets record in this Keokuk plant

TWENTY-FIVE YEARS of consistently low lubricating costs. Twenty-five years of trouble-free, maintenance-reducing performance. That is part of Standard Turbine Oil's record in its quarter-century of service at the Mississippi River Power Company plant at Keokuk Dam.

Fifteen 10,000 H.P. hydraulic turbines are in use at this plant. Since their installation in 1913 Standard's Turbine Oil has been used exclusively for both thrust bearing and governor lubrication.

Through Standard Lubrication Engineering Service this oil is tested regularly. It is centrifuged periodically. Approximately one half of one per cent of makeup oil is added monthly. Because of this care and the natural quality of the oil it has *never been changed.*

That is typical of what efficient plant management plus quality lubricants and Standard Engineering Service can do toward reducing lubricating costs. Typical, too, of what *you* can expect from Standard Service on any lubrication need.

Ask your Standard Oil representative how this Service might save money in your plant. Or, write for the booklet "The Lubrication Engineer—His Value to You," Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago, Illinois.

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STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING

THE RIGHT LUBRICANT • PROPERLY APPLIED • TO REDUCE COSTS

POWER

Established 1882 PHILIP W. SWAIN, Editor

Smallpox to Cure Measles

POWER rarely talks politics, but today we propose to handle without gloves a direct and devastating application of politics to engineering. The object of our attack is the compulsory licensing of patents.

Since 1920 at least ten bills have been introduced to limit the rights of patentees in this manner. So far none has passed, but their threat will continue until all concerned understand better how the American patent system operates in the public good.

It has been commonly said, but with little evidence, that there have been widespread abuses of the patent law, notably that patents which should be utilized in the public interests have been repeatedly shelved. Numerous bills have aimed to cure these imagined evils by the compulsory licensing of patents. A classic example was the Stanley Bill of 1922, defeated after extended testimony had proved that it would cure no important evil and would practically destroy the entire patent system.

The McFarlane Bill, HR 9259, introduced Jan 31 of this year, is proof that people forget quickly. It may have been intended to promote the public welfare and help the small business man, but its actual effect as a law would have been the exact opposite. HR 9259 gave an inventor only three years exclusive use of his own patent (instead of the present 17). After that the Commissioner of Patents could grant practically any competitor the right to operate the patent under a license, regardless of the wishes of the patentee.

After strenuous objections by many small manufacturers at the March hearing, the author of HR 9259 withdrew it and substituted HR 10068. The exclusive period was lengthened to five years and a so-called "working clause" was added, permitting the Commissioner of Patents to issue a compulsory license when "satisfactory evidence is submitted that a patent is not being used or that the domestic supply is insufficient to supply the public demand or that unfair prices or trade practices prevail."

In its requirements slightly preferable to HR 9259, this new McFarlane Bill is perhaps more dangerous, because more plausible. The working provision may look reasonable but would, in fact, be a great burden on the public and the small manufacturer, as well as the large.

Invention is a step-by-step process. It may take ten years and a long string of patents to bring an invention to the commercial stage. Under a bill like HR 10068 the manufacturer would be forced in self protection to market all sorts of half-developed devices.

The effect of such a law would be to discourage all invention, and particularly the disclosure of inventions through patents. Secrecy would be cheaper and better (but not for the public). The small inventor would rarely attempt invention with such a poor chance of reward. No one would finance him. The small manufacturer would lose the patent protection which alone permits him to compete with mass-production manufacturers.

Evidently such points as these must have impressed the Patent Committee of the House of Representatives, for the incomplete hearings were terminated before the middle of March. Compulsory licensing appears dead for this session. Yet, it will probably arise again from its ashes some day. When it does, engineers and the public should be prepared for a true evaluation and appropriate action.

In the past the inventor laid the golden egg of industrial progress. In the future, if compulsory licensing of patents should become law, none but geese will lay these golden eggs—and few geese know how.

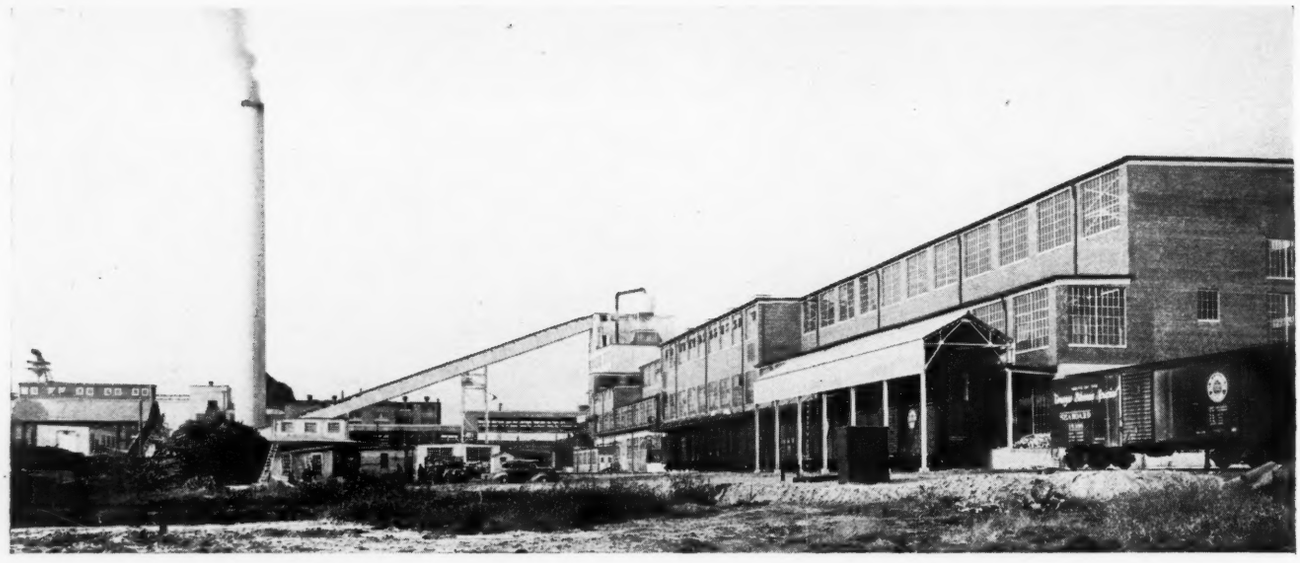


Fig. 1—General view of paper mill, saw mill, and power plant

Partners in Power

Two adjoining mills pool waste fuels and power loads in jointly owned plant at Franklin, Va. "Black-liquor" boiler salvages paper-making chemicals

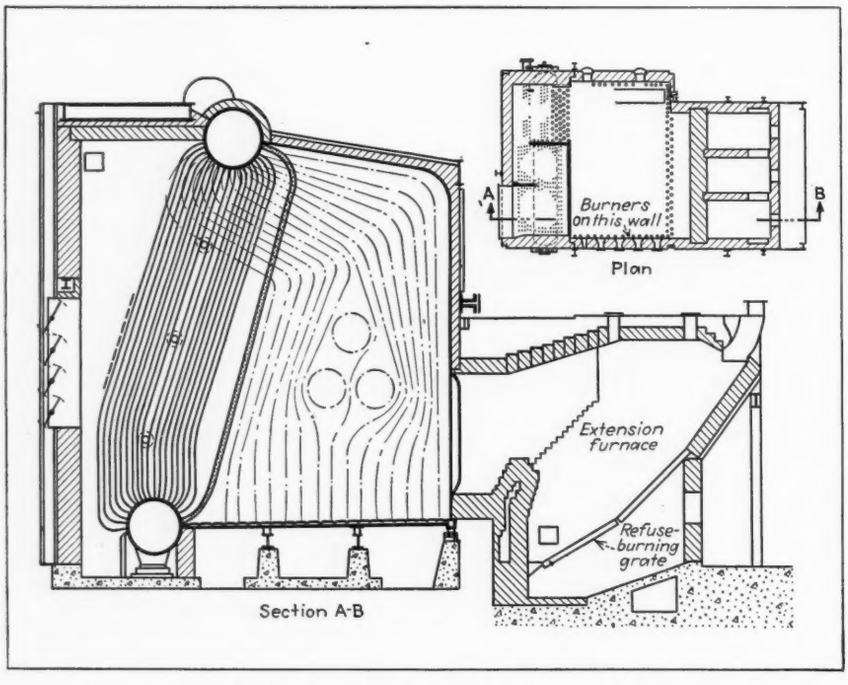


Fig. 2—Longitudinal section and plan of wood-refuse-burning boiler, showing Dutch-oven extension and inclined stoker grates

SAW AND PAPER MILL waste products are pooled and burned in a jointly used power plant at the Chesapeake-Camp Corp's new $3,500,000 Kraft paper project, Franklin, Va. Excess wood refuse from the adjacent lumber mill of the Camp Mfg Co helps carry the heavier paper-plant load so steam and power needs for both industries can be met from waste fuels. The Camp Mfg Co, of Franklin, lumbermen, and the Chesapeake Corp of West Point, Va., papermakers, together own the Chesapeake-Camp Corp.

Two wood-refuse-burning boilers and a black-liquor recovery unit generate steam at 425 lb and 675 F, and two extraction turbines, with an aggregate capacity of 8125 kva, expand steam to reduced pressures for process while making byproduct power. By combining a condensing unit with a backpressure machine, and installing pressure-reducing stations, varying demands for power and process steam can be met flexibly and economically.

Except under unusual circumstances, the major fuel for steam generation is hogged saw-mill refuse, pulpwood bark, and black liquor. About 400 to 425 tons are available daily plus about 50 tons of kiln-dried sawdust. A system of conveyors carries refuse from the saw mill to a storage building with capacity for two days' supply.

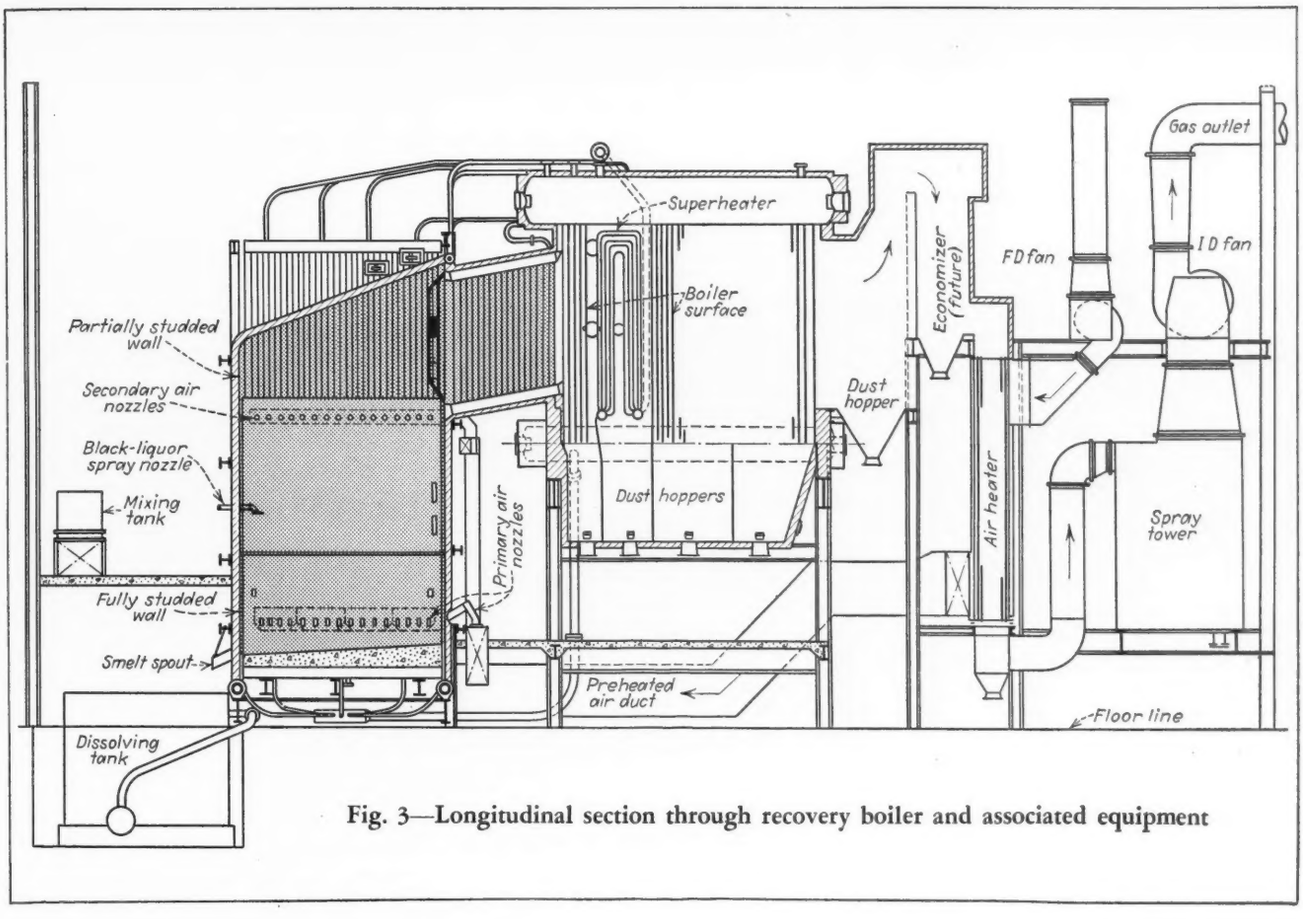


Fig. 3—Longitudinal section through recovery boiler and associated equipment

Storage building, conveyors, and provision for outdoor storage can be seen in Fig. 1. From the storage building, chain conveyors transport the fuel to 5,000-cu ft storage bins.

The two wood-refuse-burning boilers are B & W Integral-Furnace units, rated at 80,000 lb per hr when waste is fired. Total heating surface of each is 14,098 sq ft, including water-cooled walls. The inverted loop-tube superheater produces a steam temperature of 675 F when burning refuse, at full capacity. Primary combustion takes place in Hofft extension furnaces, the relative position of which can be seen in Fig. 2. Hogged refuse burns on the inclined grates of Hofft stokers, fed by spiral conveyors from storage bins above. Grates are kept filled with fuel so that the wood is dried as it slides down. A screen of tubes separates the Dutch-oven furnaces from the boiler furnaces where combustion is completed. Reference to the small plan view in Fig. 2 will indicate the path of gas around the vertical baffles.

Solid fuel from the saw mill and paper mill, together with black liquor, is expected to meet all requirements, but oil-burning equipment has been installed in case the saw mill is shut down or an unusual demand is thrown on the plant. The boiler section Fig. 2, shows the location of three B & W circular, forced-draft steam-mechanical oil burners mounted on the near furnace sidewall. Burners can be converted to pulverized-coal firing if desired, and both oil and wood can be burned at the same time. With oil, the boilers will generate 120,000 lb per hr of 660-F steam. Forced-draft fans, for use when oil is fired, are mounted on the roofs of the extension furnaces.

Black-Liquor Boiler

The black-liquor-recovery boiler, which is expected to produce about 52,000 lb per hr, is a B & W Tomlinson unit. Black liquor is a byproduct of the pulp-making process, in which pine chips are cooked in a digester with a solution of sodium hydroxide and sodium sulphide. After cooking, the pulp goes to washers preliminary to further processing, and the liquor goes to a storage tank where it is joined by a weak liquor from the pulp washing. The resulting mixture is about 17% solid, little more than half of the solids being combustible. The recovery boiler, a relatively new development, burns the combustible to make steam, and salvages chemical from ash.

Multiple-effect evaporators concentrate the watery liquor, as the first step. Then crushed salt-cake (Na_2SO_4) is added to the liquor in the mixing tank, Fig. 3, to make up for a certain amount of chemical loss in the process. A single-stage open-impeller pump delivers the liquor, now about 55% solid and at 220 F, to a nozzle in the furnace front. Designed to spray a sheet of large liquor particles, the nozzle, motor-actuated, moves in an oscillatory cycle to spread the walls evenly with liquor. Partly dried liquor particles deposit on the walls, and are dried by radiant heat, building up a char formation. Char breaks off of its own weight and falls to the hearth where it is burned with primary air injected by nozzles set around the furnace wall and pointing 30 deg downward.

Rising products of combustion meet secondary air in the upper part of the furnace and combustion is completed. Passage through the hot gas partly dries the liquor particles, but the large-particle spray prevents any extensive drying with consequent burning in suspension. Some burning of this kind does occur however and the ash, containing chemical, moves along with the gas stream. Sublimation of sodium compounds in the combustion area accounts for additional quantities of chemical in the gas. In consequence, furnace and heating surface layout is designed for straight flow with low resistance and minimum opportunity for chemical to collect on surfaces. Chemicals deposited on the boiler tubes are collected in a dust hop-

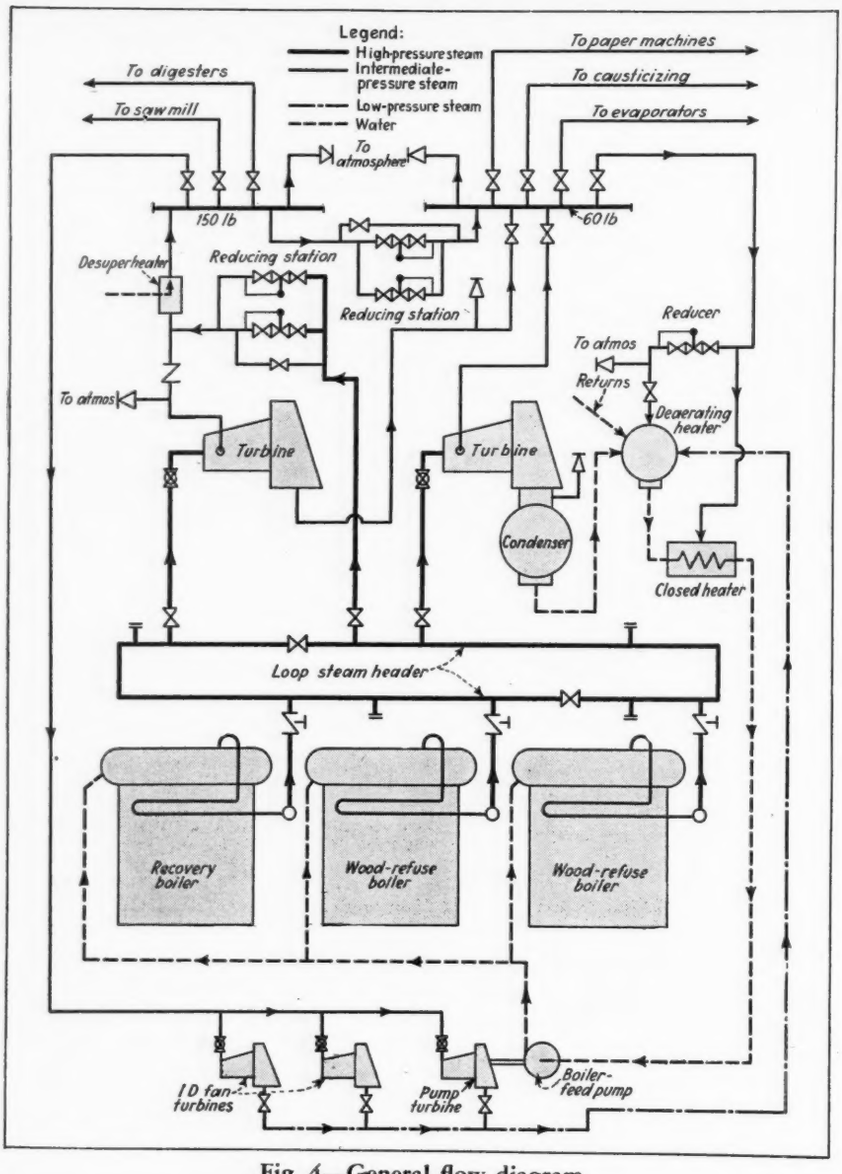


Fig. 4—General flow diagram

per below, and a spray tower just ahead of the induced-draft fans recovers additional chemicals. Molten ash tapped from the hearth at the smelt spout contains the bulk of chemical recovered.

General arrangement of the recovery boiler is illustrated in the longitudinal section, Fig. 3. Furnace walls are stud tubes, fully-studded below and partially-studded above. The three drums of the boiler parallel the long axis of the unit and are connected by tubes bent at the ends but straight for the best part of their length. Total heating surface is 9120 sq ft. A parallel-flow welded-element air heater of 6970 sq ft recovers heat from the flue gas, and provision is made for later installation of an economizer.

Induced-draft fans on all boilers discharge combustion gas into a reinforced-concrete stack, 14 ft in diameter and 250 ft high. A motor drives the fan on the recovery unit, steam turbines those on the refuse boilers.

The three boilers, with an aggregate steaming capacity of 210,000 to 290,000 lb per hr, depending on the fuel used, feed a loop header, as shown in the flow diagram, Fig. 4. Two intermediate-pressure steam systems at 150 lb and 60 lb, are supplied through the turbines and by pressure-reducing stations from the main header. A Westinghouse backpressure turbine, extracting at 150 lb and exhausting at 60 lb meets most of the steam load and drives a 3600-rpm, 2300-volt, 3-phase, 60-cycle generator rated at 3750 kva. The larger turbine, a Westinghouse with an Allis-Chalmers condenser, drives a similar generator of 4375-kva capacity. Bleeding at 60 lb provides additional process steam.

A pressure-reducing station connects the main header and the 150-lb header, and the 150- and 60-lb systems are tied together in the same way. If pressure in either system drops below desired level, flow through the reducers automatically adds to the extraction flow. A spray desuperheater, using boiler water, keeps 150-lb steam at proper temperature for saw mill use. Relief valves vent low-pressure steam to atmosphere if turbine steam output exceeds plant requirements. Load is divided between turbines to balance steam and power.

Boiler makeup, from the Black Water River, passes through Roberts filters and zeolite, sulphate, sulphite, and phosphate treatments. Initial heating of makeup and condensate takes place in an Elliott deaerating heater of 200,000 lb per hr capacity, which receives exhaust from the induced-draft-fan and boiler-feed-pump turbines. Additional heating steam is available from the 60-lb header, through a reducing valve. A closed heater, supplied with 60-lb steam, completes the feedwater heating. Continuous blowdown (Cochrane) maintains proper boiler concentration. Passing a major portion of the mill service water through the condenser and generator air coolers recovers additional heat.

The plant was designed by J E Sirrine & Co, of Greenville, S. C., and the Rust Engineering Co, of Pittsburgh, supervised purchase of equipment and construction and designed and built the stack.

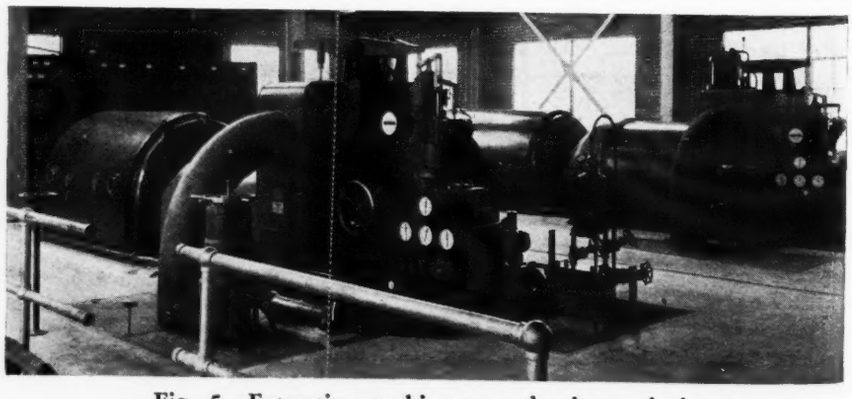


Fig. 5—Extraction turbines: condensing unit in background, back-pressure machine in foreground

Spring Cleaning Conditioners

TO POETS spring means running sap, opening buds and young love, but nothing more than hard work for power engineers getting air-conditioning equipment ready for trouble-free summer operation. Now, with weather just getting warm, and before the system is started or while operation is still intermittent, is the time to avoid troubles that would put equipment out of commission in the dog days. Thorough inspection of all parts and maintenance where needed is the recipe. Here are some pointers on the job—some things that shouldn't be forgotten.

Naturally, what will need to be done to any particular system, will depend on its condition. Some systems are completely shut down during the winter months, and in many cases, every precaution is taken to prevent deterioration during this period. In other plants, the system is checked for needed maintenance and repairs at the end of the cooling season. Partial operation, usually of the air-handling system, during the winter months is the rule in other plants. For these reasons, many of the items in the check list below will not apply. Use it for what it's worth and forget items that don't fit your case.

Spring Maintenance Check List For Air Conditioners

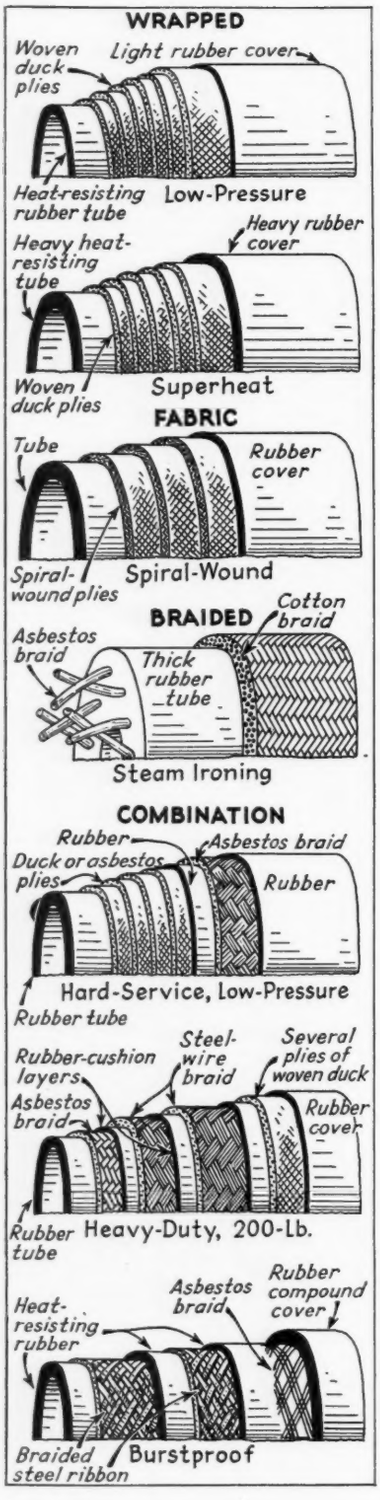
EQUIPM'NT	*MAINTENANCE OPERATIONS*
Filters	Replace clogged or dirty elements of renewable filters, entire unit if throwaway type. Clean and recharge cleanable filters.
Filters—Automatic	Clean screens, renew fluid. Clean and lubricate motor and filter bearings.
Dampers	Make sure motion is free. Check operation of controls.
Ductwork	Check hangers, brackets and supports for tightness. Take up on loose bolts to prevent rattling. Paint where needed.
Fans	Operate fans, check for unusual noises. Clean and lubricate fan bearings and motor. Replace brushes if necessary. Inspect V-belts and replace worn strands. Adjust tension.
Cooling Coils	Clean with stiff brush to remove slime or dirt on heat-transfer surfaces. Clean and flush drip pan and drain, including any traps in drain line.
Grilles or Registers	If air-supply outlets have adjustable louvres, check settings to insure proper air volumes.
Air Washers	Clean spray nozzles. Remove slime or dirt from spray headers and interior surfaces. Examine for signs of corrosion; if evident, apply protective coating. Clean sludge from bottom and make sure drain is clear.
Compressor	Clean all surfaces and oil parts not taken care of by crankcase lubrication. Clean and oil motor, replacing brushes if necessary. Inspect V-belts and replace worn strands. Adjust tension.
Compressor Controls	Clean line starter contacts or replace if burned badly. Check control-equipment operation by making and breaking contact at control points. Check direction of compressor rotation.
Condenser	Inspect water-regulating valves, replace seat if worn, repack if necessary. Remove handle of water shut-off valve to insure its remaining open. Clean strainers in water and refrigerant lines and strainer at expansion valve. Purge condenser and liquid receiver and test purge valve for leaks, using Halide torch.
Evaporative Condenser	Clean all heat-transfer surfaces. Examine interior surfaces for corrosion and repaint if necessary. Remove slime or sediment from circulating-water tank. Clean spray nozzles and distributing headers. Inspect and clean all strainers and traps. Clean and oil fan and pump motors and bearings. Inspect V-belts, replace worn strands, adjust tension. Clean intake screen and clean or replace filter, if provided. Check and adjust operation of makeup valve.
Cooling Tower	Clean spray nozzles. Check overflow connection and makeup valve. Clean and oil fan motors and lubricate drives. Inspect V-belts or drive chains, replace worn strands or links, adjust tension.
Refrig'ting System	System should have sight-flow indicator and pressure gages on high and low sides. Now is a good time to install them if not already provided. Admit refrigerant to system slowly, and check low-side for leaks, using Halide torch. If system appears tight, operation can be started in the normal manner. After some time has elapsed so that conditions are stabilized, the operation should be carefully checked. Look for high-side leaks with a Halide torch, if system operates at pressures above atmospheric. Leaks in vacuum systems can be detected by difficulty in maintaining proper vacuum. If compressor-oil level is low, add needed amount of oil. Watch sight-flow indicator and add refrigerant if solid stream of liquid refrigerant is not obtained. Then add recommended surplus. Check all valves and strainers for restrictions by looking for temperature change at questioned unit. Measure refrigerant temperature at expansion-valve bulb. If it does not agree with manufacturer's recommendation, and if valve is externally adjustable, make required adjustment. Adjust water-regulating valve until desired head pressure is obtained, also check operation of valve by shutting down compressor. Check high-pressure cutout by shutting off water supply. Compressor should be stopped before head pressure exceeds normal head pressure by 25 lb.

Note: Most manufacturers prepare detailed instructions for operating and maintaining their refrigerating systems, and the above instructions are based on data for the more commonly-used types. In all cases, consult the manufacturer's instructions for detailed information on starting-up and checking operation. The high spots given above are intended to serve as reminders.

Flexible Highways for Steam

Emergencies and every-day jobs around the power plant are all the same to steam hose. The article tells how to select and apply this versatile connection

By E J TANGERMAN
Consulting Editor



THE GREAT OHIO VALLEY flood of 1937 is almost at its peak. Louisville's water works has been fighting a losing battle to keep pressure on the mains. But the water rises and quenches the fires in the boiler house. An engineer meets the emergency by figuring that an Ohio River steam boat can be moored just outside the windows of the pump house to provide a floating boiler room. But water level is constantly shifting, waves batter the boat, the wind is rising. How can steam from the boat be gotten to the nearest huge steam pump?

The answer is steam hose. Soon four lengths connect boat boilers and pumping engine, and Louisville has water again. So ends another saga of steam hose, the flexible highway for steam, the ideal emergency connection. But steam hose has many other uses in the power plant—more prosaic to be sure—flue cleaning, boiler lancing, and temporary piping.

Two Kinds of Hose

There are two main kinds of steam hose: one made of rubber, rubber compounds, or synthetic materials, reinforced with fabric or woven metal and protected with asbestos or wire; the other made of metal formed into long bellows, or in an interlocked spiral, and in either case protected by metal braid, woven asbestos or cotton ribbon, and wire armor.

Rubber-base steam hose is commonly available in sizes from ½ to 2½ in. internal diameter, but can be had in ⅜ in. and up to 6½ in. Lining is generally heat-resisting rubber or compound, formed by extrusion. Reinforcing layers form a non-expanding envelope which takes the tensile and bursting stresses and is vulcanized to the tube.

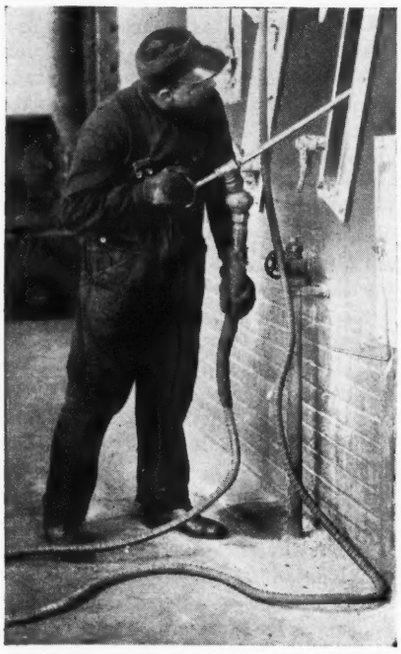
Wrapped hose has 4 to 12 plies of high-tensile duck, often with an outer coating of braid to withstand abrasion even after the heavy cover is worn through. Other types are of braided construction, with asbestos and wire replacing the cotton. Many are wound outside with oval or half-round wire to increase abrasion resistance. These are suitable for pressures up to 100 or 150 lb and temperatures to 400 F.

Special Types

Special types include one using 3 to 5 seamless circularly-woven layers of fabric to replace the combination construction, another has 8 to 12 plies of duck with double-spiralled braided-wire insert, and a third has half-round wire wound left-hand at ⅜ in. spacing (for boiler cleaning). A burstproof design good for 200 lb at high temperature, has a tube and two insulating layers of heat-resisting rubber compound, with woven flat-metal reinforcement between, woven loosely so that rubber can "rivet" around it when vulcanized. An additional braid of asbestos cord just inside the cover prevents it from burning.

All rubber steam hose is built and vulcanized over a heated mandrel. Thus stock lengths are 12½, 25 and a maximum of 50 ft. Covers, normally acid- and grease-resistant, may be reinforced with wire for additional safeguard against expansion and bending, or covered with braided or woven asbestos if exposed to burning.

"Cooking" or overheating weakens and hardens rubber, reducing flexibility. It also weakens fabric which limits hose life, so asbestos must replace cotton above 300 F, as cotton begins to char. Intermittent service is worse than continuous heating, and continuous flexing produces rapid wear. Generally, short lengths stand more pressure and for a longer time, than long ones; small diameter hose



Flexible hose on the job—hand lancing a boiler

stands more than large with the same number of plies; and a hose open at the end lasts longer than one coupled to equipment in which pressures, particularly pulsating ones, are built up. Superheated steam is harder on hose than saturated at the same pressure and most rubber hose can't stand superheated steam at all. If steam hose operating at high pressure is turned off occasionally, condensation of steam in the tube creates a vacuum, which tends to pull the tube from the carcass.

Couplings

Proper attachment of couplings increases hose life and makes for safety. Up to 50 lb, the common long-shank nipples held with a ring or screw clamp can be used, but above that special couplings, usually with clamps anchored to the nipples, are safer. Inspect new coupling stems for burrs and sharp edges and file off any that are found, before inserting the stem in the hose end. Both inside of tube and coupling stem should be covered with rubber cement. On wire-wound hose, the wire end should be turned at right angles so that it is aligned with hose axis, then securely clamped. No portion of the tube should be cut away to suit nipples or coupling stem, and if proper size stem is not available, stems at hand should be turned down.

Metal steam hose is either corrugated seamless tube or spiral-wound or interlocked metal strip. It usually costs more than equivalent rubber hose, but lasts slightly longer and can stand higher pressures and temperatures. Spiral-wound or interlocked hose can't take torsion and flexing at once; in either type pressure increases the resistance of the hose to flexing. Maximum single length of corrugated tube is 10 ft, but sections can be brazed together, stiffness at the joints not being serious in a long tube. Interlocked hose can be made in greater lengths, but even with packing at the joints is not absolutely impervious. Sizes range from $\frac{1}{8}$-in. diameter, the smallest corrugated size, to about 3 in., the largest stock size of interlocked hose. Braid-reinforced metal hose can stand pressures up to several thousand pounds.

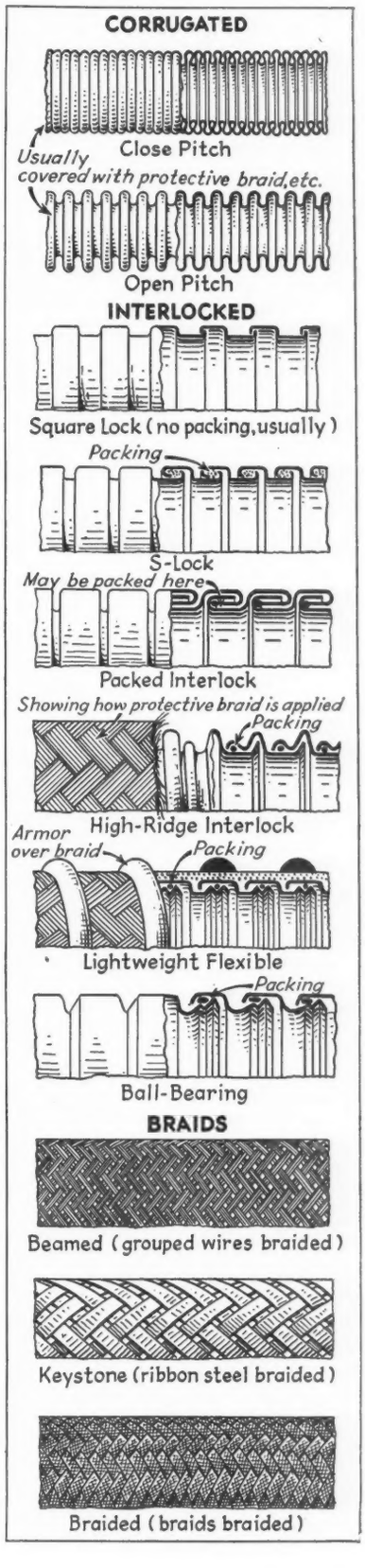
Corrugated Hose

Corrugated hose is made by crimping extruded seamless or welded tube. Not as flexible as the interlocked, it is better able to stand torque stresses and is impervious. Wall thickness may be as low as 0.008 in. in small sizes and as much as 0.030 in. Normal or "open" pitch tubing with straight wall corrugations is not as flexible as "close" pitch but is lighter and cheaper.

Spiral wound or interlocked metal hose is made by grooving strip, which is then wound on a mandrel with the overlapping edges forming a lock joint. Joints are gasketed with cotton for normal pressures and temperatures, asbestos for higher temperatures, copper for high pressures and superheat, and rubber to seal against gas. Most fibrous-packed types have lubricated tubing to increase flexibility, although a normal interlocked $\frac{3}{4}$-in. hose will coil in 8 to 12 in.

For saturated steam up to 25 lb and 400 F, hose made of 85% copper-15% zinc is widely used. For superheated steam, added strength, or sudden temperature changes, Monel replaces this alloy, and steel takes care of increased abrasion. Corrugated hose can be had in steel, bronze and Monel, while spiral hose can be supplied in stainless steel, steel, bronze, brass, Monel, or aluminum. In general, steel is recommended for temperatures up to 1000 F, and bronze is good up to 450 F. Where vibration resistance is a factor, the corrugated hose, generally bronze and Monel, is preferred.

The second illustration shows three types of braid used over metal tube for reinforcement; layers are added to increase strength. Braid materials vary: bronze is commonest, with steel becoming more widely used. Aluminum gives lightness, stainless steel resistance to corrosion. A wound-wire helix or interlocked casing, without packing, over the braid protects against abrasion, makes kinking impossible, and avoids injury from frayed braid. Extra layers of braid at hose ends reduce stress concentration and are practical because metal hose is normally sold with fittings attached. These may be applied by soldering, brazing, or by using pressure or compression fittings. The corrugated tubing has an advantage in that renewing fittings is comparatively simple.



Low-Cost Diesel Decade

Four 1250-hp engines round out ten years of economical operation at Ponca City, Okla. Additional 2250-hp unit installed in 1937

By GLENN C BOYER
Associate Engineer, Burns & McDonnell Engineering Co

TEN YEARS AGO, the last of four 1250-hp diesels went into service in the all-diesel municipal plant at Ponca City, Okla., completing the first stage of its development. In the intervening decade these engines have rung up a remarkable operating record, burning low-grade oil to make cheap power, and doing it on average maintenance costs of approximately one-third of a mill per kwhr. When a capacity increase was necessary, the only question was "how big a diesel shall it be?" The answer, based on extensive studies of the plant's needs, was 1500 kw; the new 2250-hp unit went into operation at the end of 1937.

Before taking a look at the new engine, let's take a look at the record, let's see why it can be called "low-cost diesel decade." The four older machines are rated at 1250 brake hp, 850 kw, and are Nordberg, Type EG, 2-cycle, air-injection engines. Since installation they have burned a low-grade oil obtained from the local Con-

TABLE I — MAINTENANCE DATA — PONCA CITY MUNICIPAL PLANT

ENGINES INSTALLED

No. 1	1250 hp	Nordberg Type EG	2-Cycle, Air Injection	Jan. 1924
No. 2	1250 hp	Nordberg Type EG	2-Cycle, Air Injection	Mar. 1926
Nos. 3, 4	1250 hp	Nordberg Type EG	2-Cycle, Air Injection	Apr. 1928
No. 5	2250 hp	Nordberg Type TA-216	2-Cycle, Air Injection	Nov. 1937

MAINTENANCE COSTS

Year ending June 30	*Total kwhr Produced*	*Total Maintenance Cost*	*Cost per hp Installed*	*Cost per kwhr in Mills*
1929	7,955,600	$3,873.55	$0.774	0.487
1930	8,470,800	2,671.00	0.534	0.315
1931	8,839,200	2,660.85	0.531	0.301
1932	8,718,700	1,621.90	0.325	0.186
1933	8,624,600	2,373.38	0.475	0.275
1934	9,161,800	3,580.18	0.717	0.392
1935	9,637,400	3,205.19	0.640	0.333
1936	10,115,500	3,849.04	0.770	0.381
1937	11,017,400	4,538.74	0.908	0.413
Total	*82,541,000*	*$28,373.83*	.....	.....
Average	*9,171,222*	*3,152.65*	*$0.630*	*0.344 M.*

OPERATING HOURS

Year ending Dec. 31	*Engine No. 1*	*Engine No. 2*	*Engine No. 3*	*Engine No. 4*
1929	5,103	5,728	2,971	913
1930	5,332	6,155	2,606	1,473
1931	5,572	6,345	3,167	736
1932	5,261	5,614	2,444	1,938
1933	5,181	5,765	2,247	2,616
1934	3,600	4,683	5,104	3,416
1935	3,494	5,608	5,371	2,809
1936	5,083	6,042	4,568	2,937
1937	4,300	5,827	4,391	3,188

MAJOR PART REPLACEMENTS

1 — Set cyl liners	1 — Set cyl liners	1 — Set cyl liners	1 — Set cyl liners
2 — Bottom half main bearing shells	1 — Inner cyl head	3 — Inner cyl head	1 — Set camshaft gears
1 — Xhd bearing	1 — Rebab't crank-pin bearing	3 — Rebab't crank-pin bearings	1 — Xhd bearing
1 — Rebab't crank-pin bearing	3 — Xhd bearings	1 — Piston head	1 — Rebab't crank-pin bearing
1 — Inner cyl head		4 — Xhd bearings	1 — Inner cyl head
		1 — Liner for h-p compressor	

Balance consists of piston rings, compressor valves, miscellaneous small parts and gaskets. Engines are running with original piston heads, piston skirts, and wrist pins, except for piston head on No. 3.

tinental Oil Co refinery, laid down at the power plant at prices ranging from 0.95c. to 1.81c. per gal. A recent analysis of the fuel oil, which may be considered typical of the oil used for years, showed a specific gravity of 10.8 deg Baumé; flash point 265 F; carbon residue (Conradson), 9.75%; viscosity at 100 F (Saybolt Universal), 452; and asphalt at 100-F penetration, 43.9%. During the year 1936, the four 850-kw engine-generator sets averaged 10.1 kwhr per gal. of fuel oil and 2249 kwhr per gal. of lubricating oil. Performance during past years has never been far from these figures.

Fuel oil has been prepared for use in the engines both by centrifuging and by heating. As a result of operating for different periods by each method, it has been found that in this particular case fuel oil could be conditioned as effectively with heat, in the tanks provided for that purpose, as it could with centrifuges. Heating has been the method of fuel-oil conditioning during the past several years.

Experience in this plant demonstrates that low-grade fuel can be burned in large units economically, and with low maintenance costs. Table I gives maintenance costs and operating hours for the four engines for the years since they first operated together—the first two engines were installed somewhat before the others, so they are more than ten years old. The table also indicates the major repairs required during the period covered. It is interesting to note that the original piston heads, skirts, and wrist-pins are still in service, with the exception of a single piston-head replacement on No. 3 unit.

New Engine

So much for the record—what's the new engine like? In the first place it's another Nordberg, a Type TA-216 this time. A glance at Table II indicates how it stacks up against the old engines and also gives an interesting picture of the development of large diesel engines during the last ten years. Fuel consumption of the new unit, as determined by test, beats the guarantee by 5.7% at a test load of 1,342 kw. These tests indicate an energy production of 13.95 kwhr per gal. of fuel.

This newest unit possesses several interesting features both from the mechanical and electrical standpoints. Governors on the four units previously installed gave a considerable speed droop from no load to full load, but the Woodward governor on the new unit is set at zero speed droop, when operating alone. When other machines in the plant are operated with it, it is necessary to change the speed droop on the 1500-kw unit to keep it from taking more than its share of plant load.

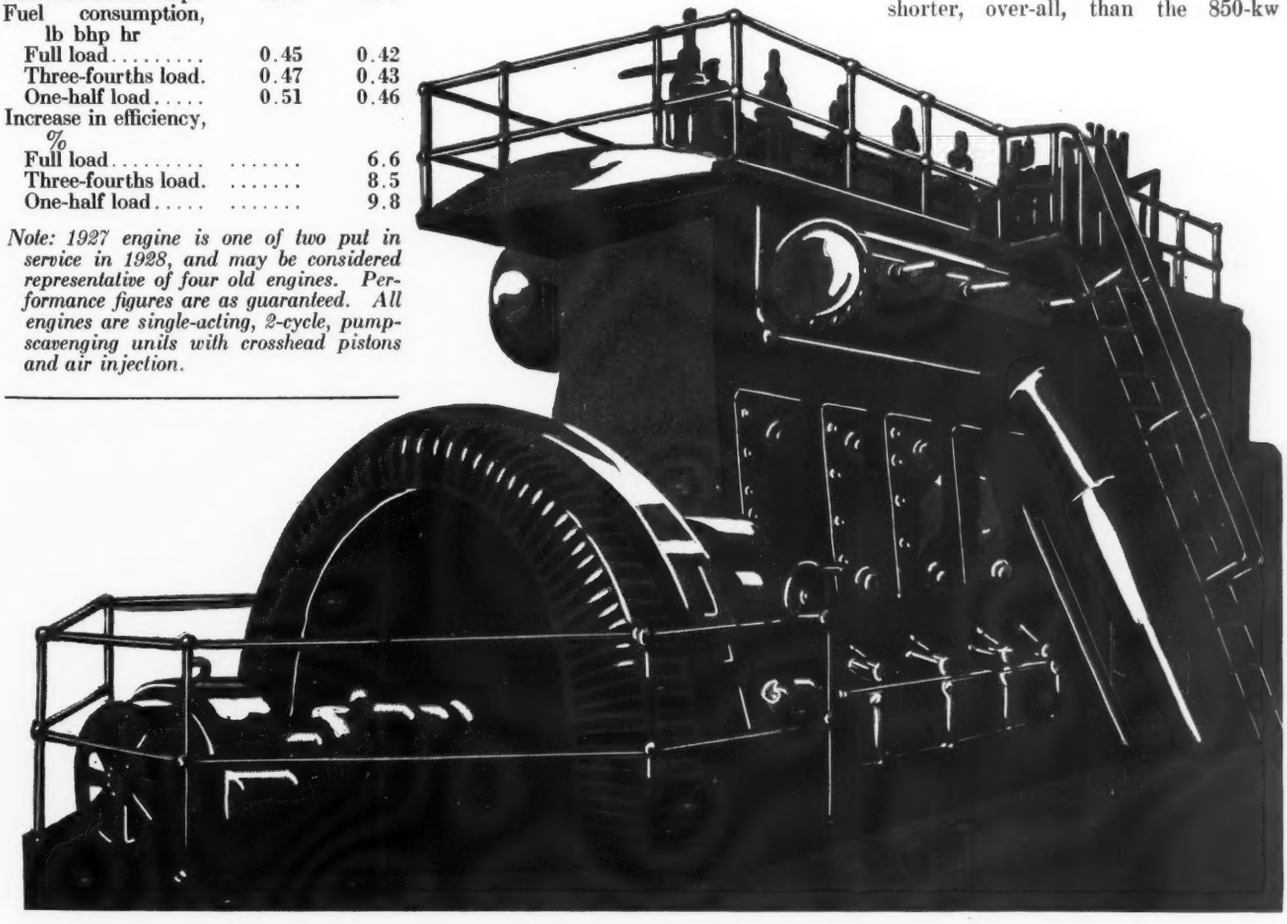
An electric motor drives the barring-over device, and a mechanical interlock with the starting lever on the engine prevents starting the engine with the barring-over device engaged. Likewise, the interlock makes it impossible to engage or operate the barring-over unit when the engine is running.

High ambient air temperatures prevailing in summer months (in the neighborhood of 120 F) made it advisable to design the generator for a maximum rise of 40 C instead of the conventional 50 C. Circulating air fans on the rotor take suction from the plant basement below the operating floor, and discharge into the building above the operating floor. The flywheel rotor was fabricated by welding. Elimination of a separate flywheel, together with advances in design, produce a 1500-kw unit that is 6 ft shorter, over-all, than the 850-kw

TABLE II
ENGINE COMPARISON

	1927	1937
Date of purchase		
Manufacturer	Nordberg	Nordberg
Type of engine	EG	TA-216
Rated full-load bhp	1250	2250
Number of cylinders	5	6
Bore and stroke, in.	20.75x26	21x29
Rotative speed, rpm	180	225
Piston speed, fpm	780	1088
Full-load brake mep	62.6	65.7
Fuel consumption, lb bhp hr		
Full load	0.45	0.42
Three-fourths load	0.47	0.43
One-half load	0.51	0.46
Increase in efficiency, %		
Full load	.....	6.6
Three-fourths load	.....	8.5
One-half load	.....	9.8

Note: 1927 engine is one of two put in service in 1928, and may be considered representative of four old engines. Performance figures are as guaranteed. All engines are single-acting, 2-cycle, pump-scavenging units with crosshead pistons and air injection.



machines installed in the years 1924, -26 and -28.

Fuel oil for the new unit is pumped to an elevated day tank of 3,000 gal. capacity located on a balcony in the power-plant building. From this tank, oil flows by gravity to a 300-gal. hopper-bottom tank for heating and conditioning. A float-controlled admission valve maintains constant oil level. Jacket water, further heated in a coil in the muffler, warms the oil and helps precipitate the sludge and water.

An inspection of the plant after the new unit was placed in service, indicated that changes in engine design in the last ten years have produced machines that can be placed in service in from one-fourth to one-third the time of their predecessors. Operators in this plant start the 2250-hp unit and have it on the line in from five to seven minutes. The older machines require from 15 to 20 minutes to start and bring under load.

New generating capacity wasn't all that was needed at Ponca City's plant—it was necessary to either reconstruct the existing switchboard or install a new one. The latter move was decided upon, and an 18-section combination metal-clad and cubicle switchgear replaced the old marble switchboard with remote-controlled breakers. New gear includes two exciter and five generator cubicles, a totalizing and regulator cubicle, and ten metal-clad units for the various feeder circuits and street lights. Installation of new switchgear in the space occupied by the existing equipment took place without a single interruption to service and no difficulties were experienced during the changeover.

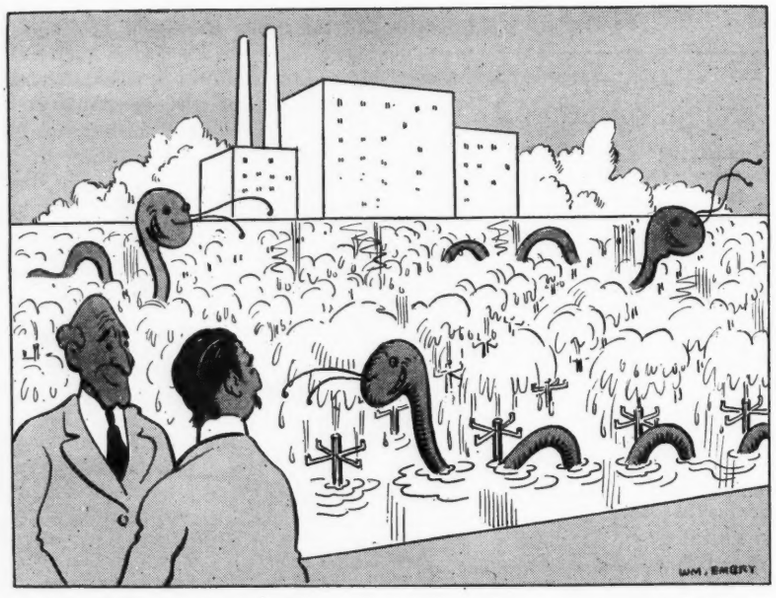
All engineering work in connection with this program was handled by Burns & McDonnell Engineering Co. Nordberg Mfg Co furnished the engine, Allis-Chalmers Mfg Co the generator and exciter, and General Electric Co the switchgear. New equipment cost $175,000, installed.

Exhaust Lines

Just when we thought we had spotted the shortest railroad, along comes Clifford R Reese, *Power* reader of Pittston, Pa., who wants to place a challenger in the running. *Power's* candidate, 4.6 miles long, is a whole mile longer than the West Pittston and Exeter, which runs between West Pittston and Harding, Pa, and hauls freight and coal for the Scranton Electric Co's power plant and the Sullivan Trail Coal Co. Three locomotives and associated cars are maintained in first class condition and none of the line's employees has had any slack time in the last ten years. Who's got a shorter railroad?

Speaking of size records, two giant gears in the shaft drive of the new Cunard-White Star liner Mauretania will be 46 ft in diameter, with 500 —count 'em—teeth. These are the largest in any ship yet built, not excepting the Queen Mary. Incidentally, aluminum-alloy funnels will save weight and retard corrosion on the new superliner.

Add refrigeration engineers to the roster of "death fighters"—at this moment lives are being saved by new refrigeration developments. In cooperation with health workers, the "cold makers" have perfected means for preserving mother's milk for later use. Quick freezing at temperatures lower than —100 F, followed by storage at —15 F, holds the essential qualities unaltered. Dramatic demonstration of the potentialities of the plan was given recently when milk flown from Boston brought life to a baby in Indianapolis. Not long ago, newspapers carried stories about pioneer work in storing blood for transfusions—Russian scientists established its practicality. Now, in U S, hospitals maintain "blood banks," keeping all types available for emergencies, carefully preserved by refrigeration. And still another link in the medical defenses is a special method, employing quick freezing, for storing serums. With it, isolated communities can battle epidemics without dependence on outside help.



"I told you to get after those algae before it was too late"

Noisy manhole covers on the tunnels of the Government-building heating system in Washington disturbed the justly-earned slumbers of the Vice-President and a host of lesser men. Strongbacks wouldn't work, but a little scouting dug up a sticky ¼-in thick tape that seemed to stop the trouble when applied around the manhole-cover rim. Tape was applied at sore spots in the dead of night, without advertising the attempt at a cure. Discovery came when the boss missed regular complaints.

In February *Exhaust Lines* we handed the palm to the 1,000,000-sq ft Hindenberg Hall at Krupp's works in Essen, for being the largest manufacturing building in the world, but it looks now as if we'll soon have to take it back or get a larger palm. According to Charles A Haynes of Detroit, Henry Ford, apparently not content with owning the largest industrial power plant in the world, will have the largest manufacturing building also when the new press shop at River Rouge is completed. Its floor area will exceed 1,400,000 sq ft.

More Than Mud Catchers

Internal mud drums help control corrosion as well as keep down solids concentration in boiler drum

By HARRY M SPRING

INTERNAL MUD DRUMS, built into certain types of water-tube boilers, do a double job of keeping solids concentration down and aiding corrosion control. A glance at Fig. 1 will show how the first and better-known part of this double job is accomplished. Feedwater enters the internal pipe near the front, flows to the rear and then back to the front. Passage through the drum raises feed temperature to almost that of the boiler water. At the back of the mud drum, where flow slows up and reverses direction, a good proportion of the solids are precipitated. The blowdown connection at the rear of the drum permits blowing out accumulated sediment and sludge.

Corrosion Control

The equally important second part of the job done by the internal mud drum has to do with corrosion control, especially in small plants where deaerating heaters cannot be afforded. Feedwater in such plants usually carries moderate amounts of dissolved oxygen which accelerates corrosion and pitting of the internal surfaces of the boilers. Note in Fig. 1 that feedwater discharges into the boiler water from the front of the mud drum, not far from the steam outlet. Thus, steam flow from the boiler carries away a fair proportion of the oxygen, reducing active corrosion. An efficient form of dry pipe maintains a reasonably high quality of dry steam.

Recent inspection of a large boiler unit of this type revealed what happens when the internal mud drum is not allowed to do both its jobs. The engineer of this plant, some eight or ten years ago, decided that it was too much bother to remove the handhole usually installed on the end of the mud drum, for cleaning, since he couldn't see any particular use for the drum. He cut a 12-in. square out of the top of the drum and then blanked off the blowdown line.

First result of the change was an increase in sludge deposits all through the boiler. Tubes in the lower row bulged and bagged frequently due to overheating caused by sludge and scale. Replacements were frequent but no one attributed them to the change in the mud drum. In addition to the cost of tubes and the time lost during replacement, loss of boiler efficiency due to poor heat transfer must be added. But that was only the beginning.

Changing the drum defeated the second part of its 2-part job, although the results were not so apparent from year to year as was tube fouling. After about ten years, a careful inspection disclosed a serious deterioration of the boiler drum close to the cut in the mud drum. As a result of the change, oxygen-bearing feedwater had discharged into a different zone of the boiler water and little of the oxygen had escaped to the steam space. The penetration rate of this localized corrosion made it difficult to notice in one or two years. But ten years of action caused serious damage to the boiler.

Relocating Drum

An idea successfully worked out in some smaller plants troubled with feedwater bearing more than the usual amounts of dissolved oxygen is shown in Fig. 2. The internal mud drum is shown relocated in the lower part of the steam space. Feedwater enters at the top as before and blowdown is from the rear, but the entire top of the drum has been cut off. Feedwater now drips down in a spray from the sides and ends, liberating a large amount of free oxygen into the steam space. A final pointer—if this change is made, a steam separator should be provided to guard against moisture carryover.

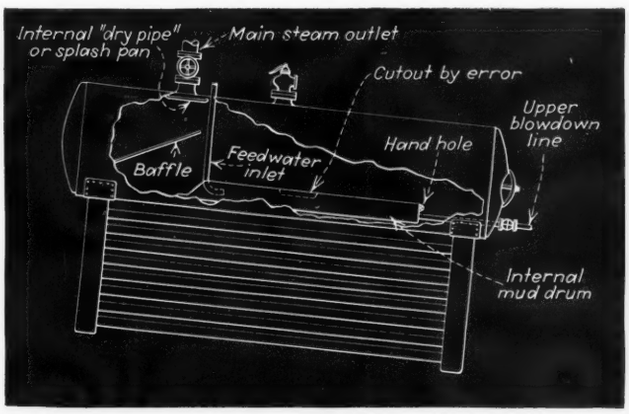


Fig. 1—Internal mud drum in water-tube boiler

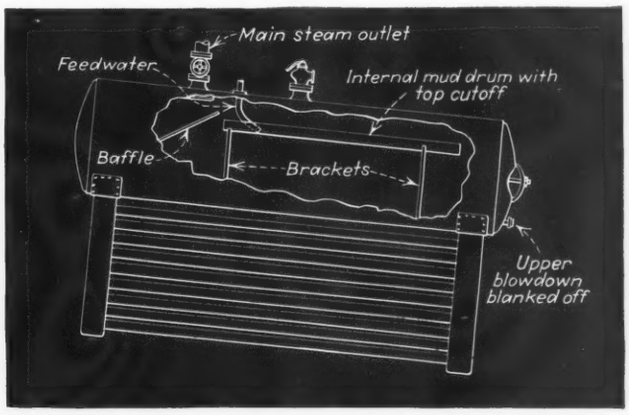


Fig. 2—Relocation of internal mud drum

Sizing Pipe for Compressed Air

Compressed air may be thin stuff, but at high velocity inside a pipeline, it can cause serious pressure drop and pulsations. The answer is to select proper sized piping

By J M BARTHOLOMEW
Compressor Engrg Dept, Sullivan Machinery Co

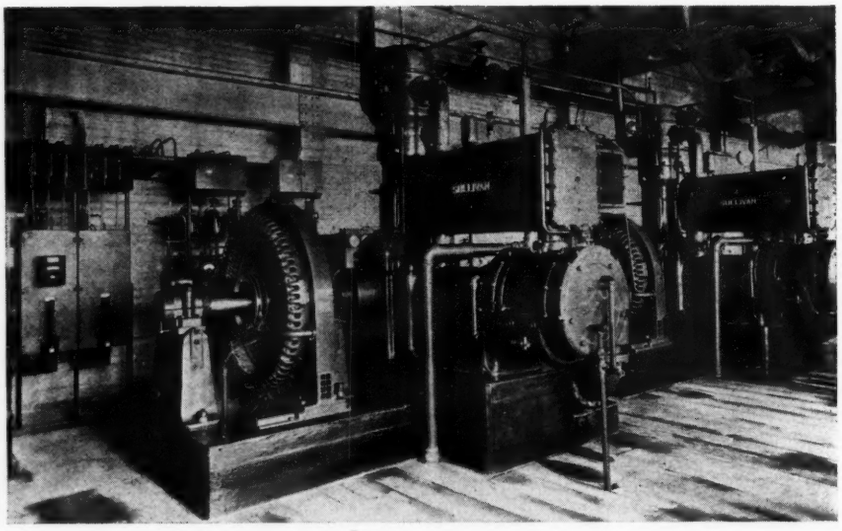
COMPRESSED-AIR in industrial plants has found increasing application because of greater use of air tools, paint-spraying apparatus, etc. Too frequently, pipelines have grown without any systematic planning for existing conditions. Compressor capacity has been added without increasing pipeline size or receiver capacity, all of which may increase cost of supplying the air and decrease efficiency of air-operated devices.

Losses in compressed-air lines are caused by friction of air on the inside of pipe and fittings, pulsations of air pressure and by air leakage. Pipelines that are too small for volume of air handled cause excessive pressure drop and power loss. Length of pipe between compressor and receiver or between compressor and a right-angle bend in the discharge, may be such that it will produce surges in resonance with the frequency of high-pressure-cylinder discharge. When such surges occur, discharge pressure will be higher than normal with a corresponding power loss. For every 1% of air lost by leakage, the compressor must operate that much longer with an equal power increase, and loss in production efficiency because of unsatisfactory service from air-operated devices may be even greater.

Correcting Losses

Excessive loss in air lines, elbows and fittings can be avoided by using proper size pipe, correctly planning the distribution system and by maintaining all compressed-air equipment in good condition.

Discharge from an air-compressor cylinder takes place during about one-half of a stroke on a 2-stage machine and for about one-quarter of a stroke on a single-stage unit. Pipe capacity must be large enough to transmit the discharge without excessive increase in pressure.



Two 225-hp synchronous motors drive angle-compound air compressors in cement plant

In Fig. 1, curve *A* gives recommended compressor-discharge pipeline sizes for single-stage compressors, and curve *B*, for two-stage compressors. Pipelines from receiver to point of distribution or use may be smaller than from compressor to receiver since, for the former, air flow is steady and air volume reduces in cooling. Compressed-air transmission of necessity entails pressure drop; 1% loss per 100 ft of pipe at full-line capacity has been selected as normal. Curve *C*, Fig. 1, shows pipe sizes on this basis. Since demand varies, average loss will be less than 1%. For comparison, pipe sizes giving a calculated 5% loss per 100 ft at a corresponding rate of air flow are shown by curve *D*. Because of special problems encountered in large plants, the curves are carried only to capacities of 2500 cfm.

Length of pipe includes an equivalent length for elbows, valves and other fittings. Complete data on the proper equivalent to use for different fittings will be found in most valve and fitting catalogs and in engineering handbooks. A good set of these curves appeared in "Fluid Highways," Mid-December, 1937 *Power*, pages 786-7.

As an example of how to use the curves in Fig. 1, assume that a typical industrial plant uses a maximum of 1000 cfm of air and has 200 ft of compressed-air main, including equivalent length for fittings, between receivers and where branch lines lead off to points of use. According to curve *C*, the distribution line should be at least a 4-in. pipe. If 2.5-in. pipe were used, loss in 200-ft length would be 10% if fully loaded, 8% at 750 cfm and 2.5% at 500 cfm. Assume 750 cfm and a power input of 112 kw to compressor motor at this capacity. Taking the average loss at 8%, power loss is 8.96 kwhr per hr, which at 2 cents per kwhr represents a cost of $7.16 per 40-hr week, or $372.30 for a year. Many plants operate two and even three shifts, which would increase the loss correspondingly. A large part of this can be saved by replacing piping with lines of adequate size.

Indicator diagrams, Fig. 2, show a condition where the pipeline from compressor to receiver is so small that it causes an excessive pressure increase each time the compressor discharges. These cards were taken simultaneously

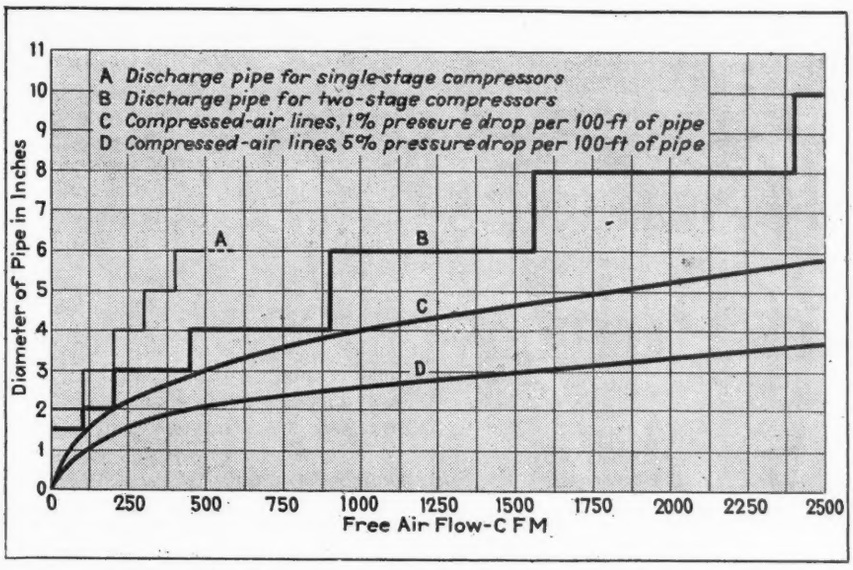

A Discharge pipe for single-stage compressors
B Discharge pipe for two-stage compressors
C Compressed-air lines, 1% pressure drop per 100-ft of pipe
D Compressed-air lines, 5% pressure drop per 100-ft of pipe
Diameter of Pipe in Inches
Free Air Flow-C F M
0 250 500 750 1000 1250 1500 1750 2000 2250 2500
0 1 2 3 4 5 6 7 8 9 10 11
A
B
C
D

Fig. 1—Recommended pipe sizes for transmitting compressed air at 100-lb pressure

on the high-pressure cylinder and on the discharge line, the indicator drive in both cases being connected to the high-pressure crosshead. Normally, this compressor requires 250 hp for continuous operation against 100-lb pressure, but in this case required 265 hp, which caused the driving motor to overheat. Assuming 2 cents per kw-hr, additional power cost for a 40-hr week would be $9.75. The dotted line shows the cards after a larger pipe was installed.

An aftercooler near the compressor discharge can correct what might otherwise be an unsatisfactory pipe layout. Although the most important function of the aftercooler is to cool the air and allow excess moisture, oil, and dust to be deposited, cooling also reduces the air volume that must be carried through the rest of the pipe to the receiver. As a general rule, aftercoolers have more capacity than the pipeline. This additional capacity together with the aftercooler baffling tends to smooth out the air flow through the rest of the line.

Effects of pipeline surges are best illustrated by a typical compressor and compressor-discharge pipeline indicator card, Fig. 3. Compressor-discharge pulsations set up in the pipeline were of such frequency that the waves returned to the compressor at the instant of the next discharge from the cylinder. This resonance causes a build up in pressure for part of the cycle and increases the work required to deliver the air to the line. During the rest of the cycle, pressure may fall below normal to give an average of 100 lb, as indicated on a well-damped gage connected to this line.

The cards show about 30 hp excess load due to pipeline pulsations, which was corrected by using a pipe tee and a short length of pipe to act as a surge chamber in the compressor-discharge line. Pipeline and compressor indicator diagrams, taken after the change was made, are shown in dotted lines, Fig. 3. The lower compression lines were probably caused by lower temperature of the cylinder liners, as the discharge-air temperature dropped from 240 to 225 F after the surge pipe was installed.

Detecting Surges

Resonance in the discharge pipe may be suspected if the motor is overheating or if power requirements are higher than expected. To determine existence of pipeline surges take an indicator card on the line with a standard-engine indicator. To guard against conditions which might cause excessive power consumption, make diagrams whenever a new machine is put into service. If surge occurs, install a short length of pipe near the compressor discharge to act as a surge chamber. If the pipeline makes a right-angle turn near the high-pressure cylinder, use a tee instead of an elbow and install a short section of pipe, equal to about half the high-pressure-cylinder volume, as a surge tank. Use long radius elbows whenever possible in air lines between compressor and receiver.

Pipeline leakage accounts for as much as 10% of the air used in most industrial plants. Check this figure in your own plant by operating the compressor on a Sunday or holiday when all machines are shut down. Much of this loss can be avoided by replacing defective safety valves, shut-off valves and gaskets in pipeline joints, receiver inspection openings, etc. If a pipeline is improperly hung so that weight or expansion causes sag, flanged joints will generally leak badly.

Fig. 2—Compressor and pipeline cards showing additional power required in second-stage cylinder because of small discharge line. Dotted lines show power reduction when pipe of recommended size is used

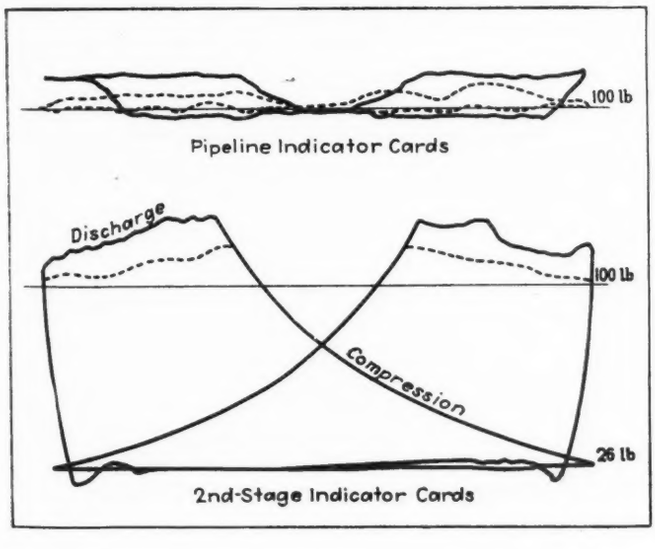
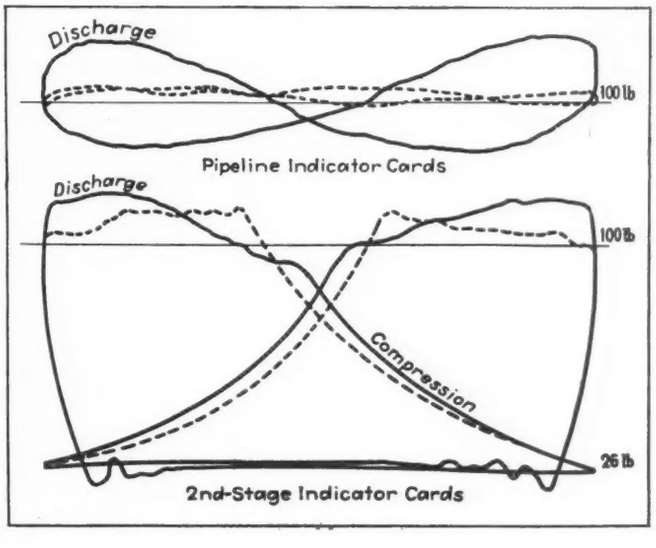


Fig. 3—Compressor and pipeline cards showing excessive power required in second-stage cylinder because of pressure pulsations. Dotted lines show reduction made by installing surge chamber



How Central Stations Control Feed Pumps

What ingenuity has done in combining standard elements to handle the special job of feedwater control in nine high-pressure central stations

By ALFRED C WENZEL
Chief Engineer, Smoot Div, Republic Flow Meters Co

THESE examples of feedwater-control systems include applications to horizontal and vertical reciprocating pumps as well as to turbine- and motor-driven centrifugal units. In some of these cases, the control operates the pumps to maintain constant excess pressure, in others, variable excess pressure. In some, the control system can be adjusted to give either constant or variable excess pressure.

The plants, with two exceptions, are 1200-lb central-station tops. Plant *H*, Fig. 5, and Plant *I*, Fig. 6, are included because they illustrate the versatility of the control system and because the pumps are unusual. Also, in all the plants except one, Plant *G*, the boiler-water-level controls are made up from the same type valves and regulators as the pump controls. Excess-pressure controls are applied for purposes other than boiler-water level control.

The principal functions of an excess-pressure feed-pump control are:

1. To maintain automatically an excess of feedwater pressure over steam pressure, at the feedwater regulating-valve inlet (either a constant amount above steam pressure or an amount varying with the rate of steam output of the boiler).

2. To operate a group of boiler-feed pumps automatically at minimum power consumption for various steaming rates of the boiler (these are large pumps, in some cases driven by prime movers of capacities as high as 2200 hp each, and any power saving is a material reduction in the cost of operation).

3. To control automatically the operation of a group of large high-pressure, high-capacity feed pumps, of both constant-speed and variable-speed types, in parallel in various combinations, and maintain stable division of load among several pumps.

As a result of excess-pressure pump control, the feedwater-regulating valve maintains its most effective regulating position and controls water level with a minimum of valve motion.

In all but Plants *G* and *H*, the boiler-water level-control systems are similar. A water-level regulator, actuated by water-level variations through a mercury-differential measuring element, operates the oil-power cylinder of a turbine-type valve in the feedwater line. Hydraulic power, thus applied to the valve, positions it accurately regardless of the pressure differential across the valve. It is not necessary to employ separate elements to cancel out the effects of pressure differential on level regulation.

It does not matter whether the pressure differential across the valves varies or not. In some cases, pump control is designed to vary this pressure differential with boiler output; accordingly, when a change in boiler-water level necessitates a change in feedwater flow, the pump control causes the pumps to change the pressure drop across the valve to give the correct flow and minimize valve travel. In other cases, however, pressure drop across the level-regulating valve is held constant and flow is regulated by movement of the level-regulating valve. The important thing is, that when this type of water-level control is installed, either method of pump control can be successfully employed, selection depending on other factors.

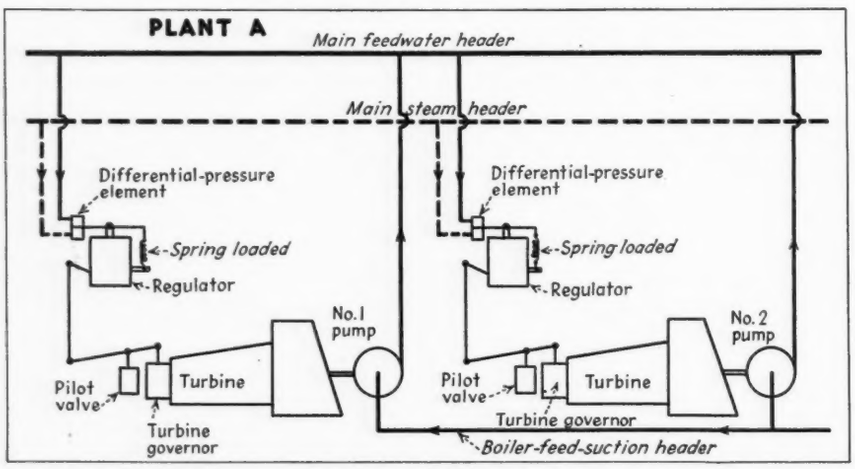


Fig. 1. Regulators vary pump speed to maintain constant excess of feedwater pressure over steam pressure

Variable-Speed Pumps

Constant-speed motor-driven pumps usually have discharge pressure controlled by a valve in the pump-discharge line actuated by a regulator. Pumps are also driven by variable-speed motors or steam turbines. The former are controlled by regulators actuating electric contactors and rheostats. Such controls for variable-speed pumps have been used in some power plants but most designers prefer not to use variable-speed motors. Turbine speed is varied by a regulator actuating the turbine governor or a valve in the steam line to the turbine, the former being the preferred method.

Pumps can also be driven through hydraulic couplings and speed controlled by regulators operating valves

in the oil circuit of the hydraulic coupling, as at Plant *K*. Variable-speed pumps driven by mechanical variable-speed drives are controlled by regulators operating the variable-speed drive adjustment. Electric variable-speed drives, such as used in Plant *H* for driving a horizontal reciprocating pump, are controlled by regulators operating contactors. An unusual control of vertical reciprocating pumps direct from water-level regulators has been developed for Plant *I*.

Simplest Pump Control

The simplest form of excess-pressure pump control consists of a regulator maintaining constant excess pressure of feedwater over steam pressure by controlling the speed of a turbine-driven pump or a valve in the discharge of a motor-driven constant-speed pump. A typical example of this application is at Plant *A*, Fig. 1. This is a 1200-lb superposition consisting of one 275,000 lb-per-hr bent-tube boiler fired by a chain-grate stoker and supplying steam at 1350 lb, 910 F to a 10,000-kw turbine, which exhausts at 215 lb g. Two 660-gpm, turbine-driven pumps supply feedwater. On each pump turbine is mounted a regulator connected as shown schematically in Fig. 1. This regulator in operating a valve in the turbine governor, varies pump speed to maintain a constant differential pressure between main-steam and feedwater headers.

Variable Excess

The pump-control system shown in Fig. 2, Plant *B*, is an amplification of that of Fig. 1. This system, in contrast to that of Fig. 1, operates the pumps automatically in parallel to vary excess feedwater pressure in relation to boiler output, providing higher excess feedwater pressure at high steaming rates when most needed and reducing the power consumption at lower steaming rates. In this control system, the regulator arrangement, governing turbine speeds by controlling their governors, has a superimposed loading pressure. The regulators, of course, differ slightly in details of construction.

The air loading pressure from the pump master controller, varying in a definite relation to boiler output, is applied to a regulator where it is balanced on a weigh-beam against a differential-pressure element to which is supplied the steam- and feedwater-header pressures. Variations of the loading pressure unbalance the regulator, which varies turbine speed and therefore pump pressure.

Variations in loading pressure are produced by the pump master controller, which in turn is loaded from the master controller of the boiler's combustion-control system. The latter, because of its design, transmits to the pump master controller a loading pressure varying as the square of boiler output, which is in turn transmitted by the pump master to the regulators, governing the pumps to vary excess pressure as the square of the boiler output.

Plant *C*, another central-station top, has a system similar to Plant *B*. In both plants, boilers operate at 1325 lb, 900 F, serving topping turbines of 35,000 kw and 30,000 kw respectively.

In each case three turbine-driven boiler-feed pumps supply feedwater to high-pressure boilers. At Plant *B*, each pump, driven by an 1100-hp turbine, has a maximum capacity of 425,000 lb of water per hour, a little greater than the maximum output of one boiler. Since there are two boilers, two pumps can carry full load, leaving the third for spare and permitting

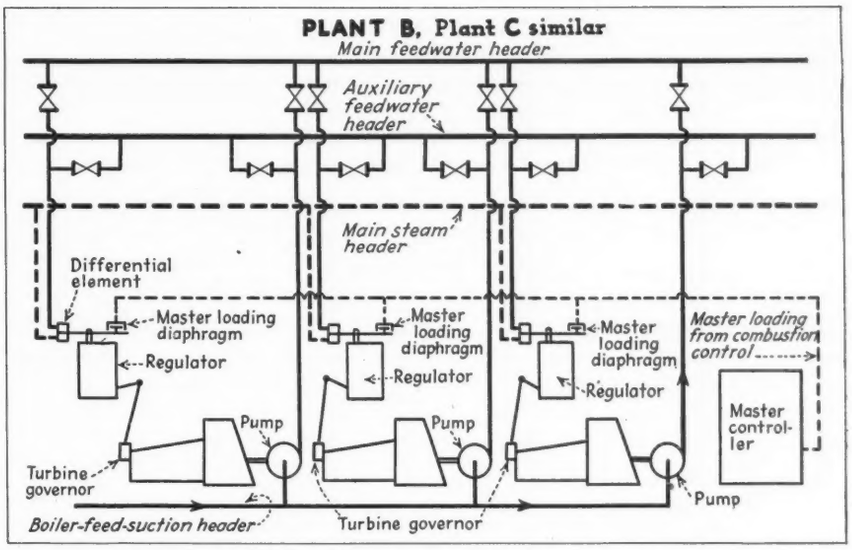


Fig. 2. Master-loaded regulators control feed-pump speed to increase excess feedwater pressure at increased boiler outputs

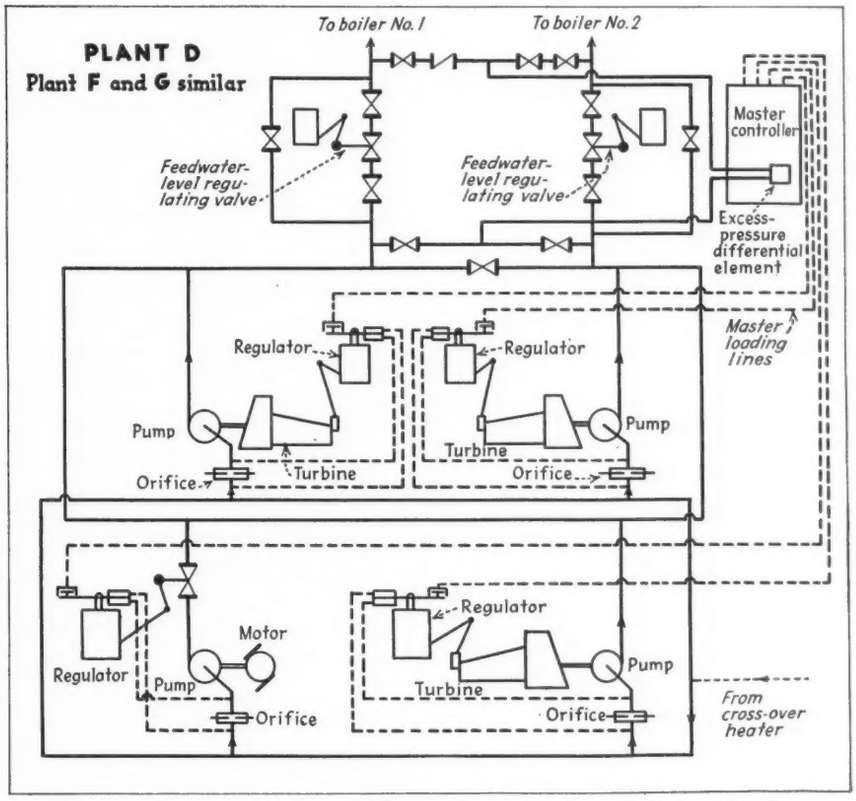


Fig. 3. Constant- and variable-speed pumps in parallel maintain constant pressure drop across feedwater valve

any desired combination of the three pumps.

In both systems, master loading for the pump regulators is taken from a common loading line. Consequently, operating pumps divide load equally.

Other Variations

Excess-pressure pump controls in Plants *D, E, F* and *G* are somewhat different from those in Plants *B* and *C*. Fig. 3 shows the connections for Plant *D*. The others, *E, F* and *G*, are similar in general arrangement and operate on the same principle. They are designed to maintain a relatively constant excess of feedwater pressure over steam pressure. In one case, at Plant *E*, Fig. 4, pressure differential between feedwater header and main-steam header is kept constant. In the other three cases, Plants *D, F* and *G*, differential pressure across the feed-water-level regulating valve is kept constant. In all four cases, the constant differential is transmitted to an element in a master controller, from which master-loading pressure is sent to individual regulators governing the pumps. In the regulators, this loading pressure is balanced on a weigh-beam against a differential pressure taken across an orifice in the suction of each pump, this differential pressure varying with the flow.

Boiler-Output Range

Of course, as boiler output varies, the pressure drop through superheater, economizer and piping also varies, hence the total feedwater pressure must change; but in the case of Plant *D*, for example, it is always in excess of steam pressure by at least the amount of pressure drop across the level-regulating valve. Using this pressure drop rather than the differential between steam and feedwater headers is preferred by some engineers because the entire control works through a range of about 50 lb instead of through the whole range of boiler drop, say 150 or 175 lb; therefore the control regulates within closer limits. It is not affected by superheater and economizer drop. When only one or two boilers are involved, either of the above differentials (across level-regulating valve or across steam and feedwater headers) can be used.

In Plants *D, E, F* and *G*, various combinations are used, constant-speed pumps driven by electric motors, variable-speed pumps by steam turbines. This is done primarily for heat balance. Only by controlling the group with a master controller can the pumps be made to operate automatically in parallel at lowest power consumption.

At Plant *E*, pump is driven by both motor and turbine and is controlled

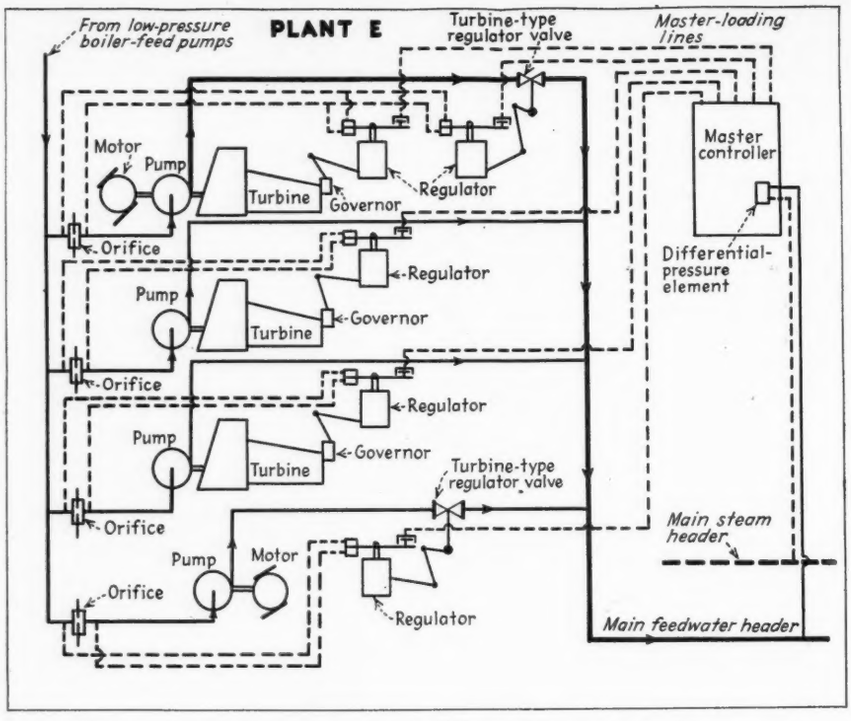


Fig. 4. Constant excess-pressure differential across feedwater and steam headers is maintained even though pumps are constant speed, variable speed and dual drive

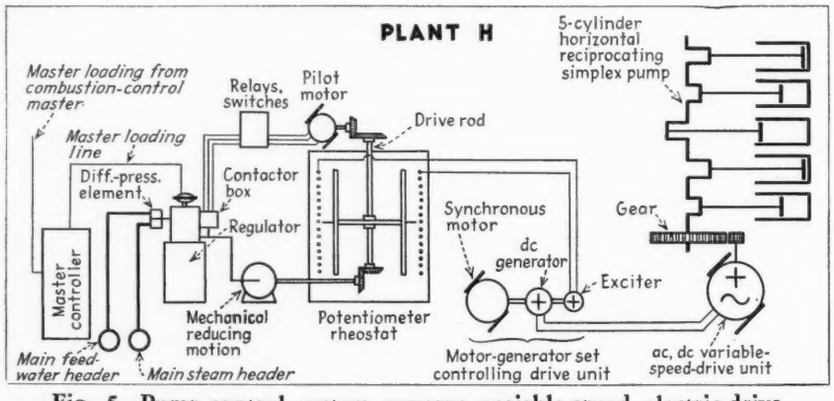


Fig. 5. Pump-control system governs variable-speed electric-drive reciprocating pumps. Excess pressure is varied

by two regulators, one operating a valve in the pump-discharge line, the other operating the turbine-governor mechanism to vary speed. Both these regulators are master-loaded from the master controller and, by varying the master loadings, through ratio adjusters, either motor or turbine drives the pump, depending on plant requirements.

In these pump controls for Plants *D, E, F* and *G*, the master controller carries manometers that show the master-loading pressure to each regulator. A ratio adjuster in each loading line can be adjusted manually to vary loading pressure to compensate for variations in pump characteristics and to divide pumping load in unequal proportions if desirable or necessary. Master controllers are also provided with an automatic-to-manual transfer valve and lever, so that the pumps may be controlled manually.

In any pump-control system of the types shown here, it is possible to sound a horn alarm and light signal lamps when boiler-feedwater flow goes below or above certain predetermined limits. Plant *E* uses the circuit shown in Fig. 7.

Reciprocating Pumps

All the above are centrifugal pumps. Reciprocating pumps, however, are used in Plant *H*, Fig. 5, one of the newest 1200-lb condensing extensions. Three pulverized-coal-fired boilers total 1,300,000 lb per hr at 850 F. Feedwater will be pumped by two 5-cylinder, single-acting horizontal reciprocating boiler-feed pumps, only one of which is yet installed. This pump has a capacity of 3000 gpm at

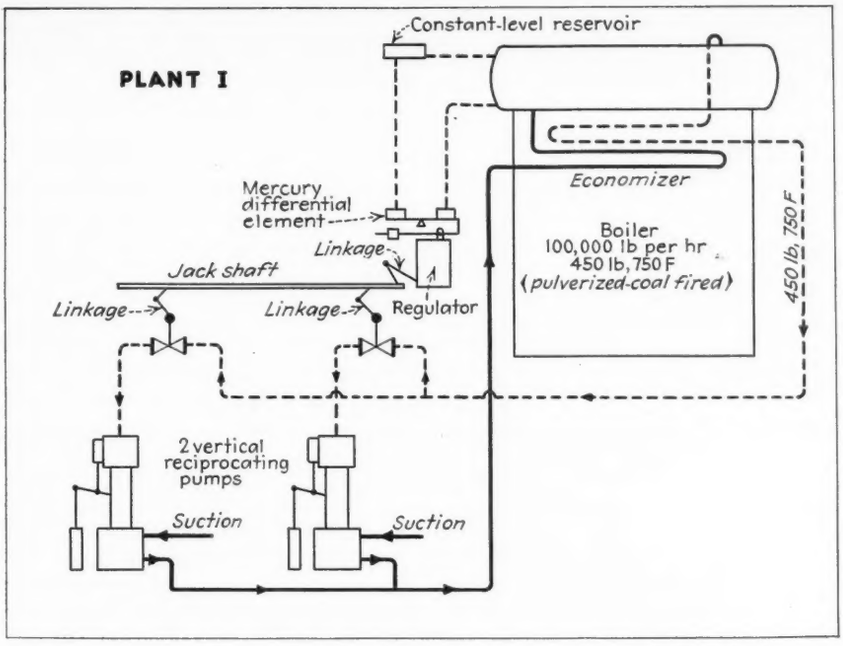


Fig. 6. Vertical reciprocating feed pumps are governed directly by water-level regulating system

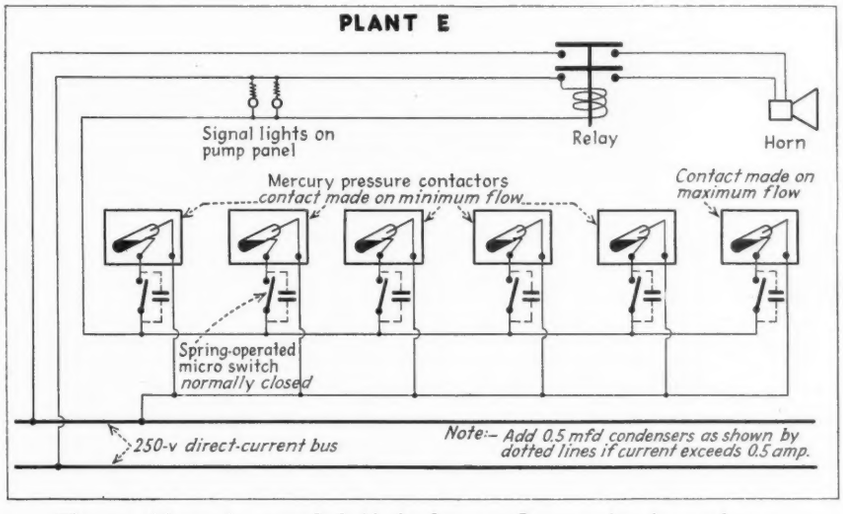


Fig. 7. Alarm is sounded if feedwater flow varies beyond predetermined limits

300 F against 150-lb discharge pressure. Centrifugal pumps serve as standby and supplementary capacity.

The reciprocating pump is driven by a variable-speed electric drive, controlled by a potentiometer rheostat to maintain a variable excess-feedwater pressure. The drive unit consists of a 1750-hp induction motor to furnish the base speed and a 750-hp dc motor for variations from the base speed. The induction motor is mounted inside the dc motor on bearings, in such a way that both stator and rotor of the induction motor rotate. The dc motor drives, or is driven by, the induction-motor frame. Power for the dc motor comes from a synchronous mg set.

When both induction and dc motors are operated, the latter is controlled so that the two motor speeds are added or subtracted, the resultant speed being transmitted through a 12-to-1 reduction gear to the pump crankshaft. Speed range of the drive is 708 to 282 rpm.

The dc motor is controlled by adjusting the field of the mg set by a motor-operated potentiometer rheostat setting. A master, loaded from the combustion control, sends a measured loading pressure, in accordance with variations in steam demand, to a regulator, which operates contactors that control a reversing pilot motor driving the potentiometer-contact arm. This pilot motor rotates a contact drive rod to cut in or out the necessary amount of the rheostat. Rotary motion of the potentiometer contact-arm drive rod is transmitted back to the operating lever of the regulator through a reducing motion, as shown in Fig. 5, opening the contactor and stopping the pilot motor. This operation is repeated, the regulator closing one contact or the other, until the pump-discharge pressure is brought to the required value.

Drum-Level Control

Another unusual control for reciprocating boiler-feed pumps has been designed for Plant *I*, Fig. 6. A boiler-water-level regulator operates valves in the steam lines to two vertical reciprocating steam pumps, varying speed and output in direct relation to variations in drum-water level. The new pulverized-coal-fired bent-tube boiler has a capacity of 100,000 lb per hr at 500 lb, 800 F, supplying a condensing-extraction, turbine-generator. Feedwater is pumped by the two pumps, capacity 150 gpm each at 12.25 double strokes per min against 500 lb g. Steam cylinders operate with 500-lb steam and exhaust at 75 lb.

The water-level regulator is a standard type in which a mercury-differential measuring element, responsive to changes in boiler-water level, operates the regulator. This turns a jack shaft, from which levers operate the pilot valves of oil-cylinder-operated turbine-type valves in the steam lines to the pumps.

Hydraulic Couplings

In some large high-pressure installations, feed pumps are driven by motors through hydraulic couplings. Power and speed are varied by controlling the flow of oil to the coupling. This is done by a regulator controlling valves in the oil circuit in response to variations in excess pressure applied to a differential element in the regulator. For a rapid change, however, a combination of regulation of the hydraulic coupling and of the controlled quantity can be employed.

The latter is the method used in Plant *K*, a large central station in which pumps are motor driven through hydraulic couplings. In this plant, a regulator on each pump operates a valve in the pump discharge to control discharge pressure and at the same time operates contacts. The contacts actuate a reversing starter that controls a motor-driven pump in the oil circuit of the hydraulic coupling, thus changing pump speed.

Nothing is easier than fault-finding; no talent, no self-denial, no brains, no character are required to set up in the grumbling business.—Robert West.

Chained Power

In selecting chain drives, remember that excess capacity pays dividends in long life, reliable service, and low cost of operation

CHAIN DRIVES are suited for medium speeds, for high temperatures, or in dirty, oily, moist or acid atmospheres, or to transmit large power in small spaces at medium and slow speeds. When speed of a machine permits direct connection to its driving unit a flexible coupling is usually the simplest and most economical drive. For small and medium size motors, speeds of 1800 to 900 rpm are most economical, but these are too high to permit direct connection to the input shafts of most machines. This is where some form of speed reducer, such as a chain drive, comes into use.

Variety of Designs

A variety of designs are available for different operating requirements, and of these, finished-steel roller chains on cut-tooth sprockets and the silent types find greatest use in industrial-power applications.

Roller chains are made of heat-treated, high-grade steel, with all bearing surfaces ground to accurate dimensions and then finished to resist wear.

If a single strand does not have sufficient power-transmitting capacity, multiple-strand chains are used, power of the chain being increased almost in proportion to the number of strands. If very large capacity is required, use two multiple-strand chains rather than a single wide one, because slight misalignment is less objectionable with a narrow chain.

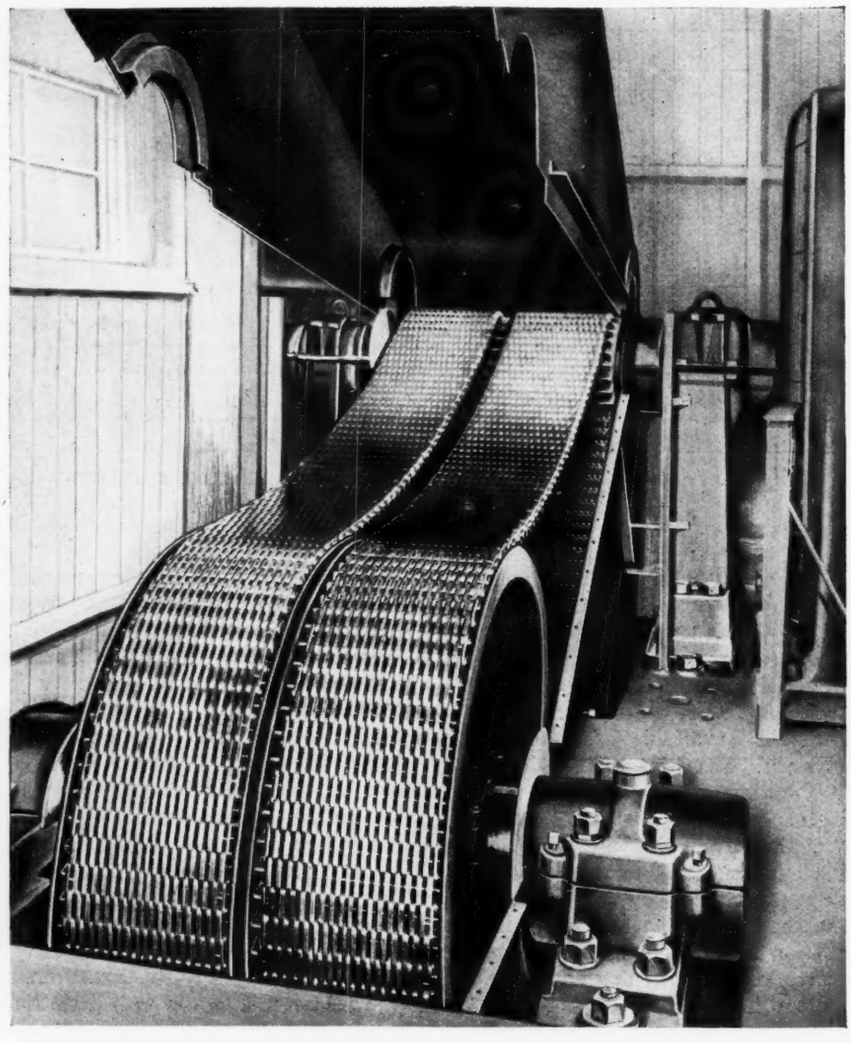
Silent chain may be considered a flexible rack designed to keep automatically proper pitch contact with the sprockets.

Chain drives may be operated in any position from horizontal to vertical, and in either direction. If vertical or nearly so, close adjustment is necessary to keep slack out of the chain. Otherwise, teeth are cut when the chain falls out of proper mesh with the lower sprocket.

Like gears, chains will transmit power up to their breaking strength and give a positive speed ratio. This, however, does not mean that they should be overloaded for long periods. Manufacturers have established chain ratings for different designs based on normal tension, and these should not be exceeded. Factors such as speed, power-unit characteristics, and operating conditions modify the allowable normal tension. Catalog ratings should be reduced about 25% when chains are subjected to severe shock loads, as for example, from internal-combustion engines, air compressors, oil-well machinery and crushers. If there is going to be any error in selecting chain drives it should be on the safe side.

An oversize chain pays dividends in satisfactory service and increased life, while an undersize one will be a source of expense and trouble. Reducing load to 75% of catolog rating and operating under normal conditions will double chain life, but a 50% increase above this rating will reduce life approximately 80%.

Either short centers between sprockets or comparatively long-center drives are satisfactory. As chains run at practically no tension, bearing loadings are at a minimum being due almost entirely to load transmitted. Sprockets may just clear each other, but best results are obtained with center distances of 30 to 50 times chain pitch. About 40 times is normal center



This double silent-chain drive connects a 750-hp wound-rotor motor to a rubber mill

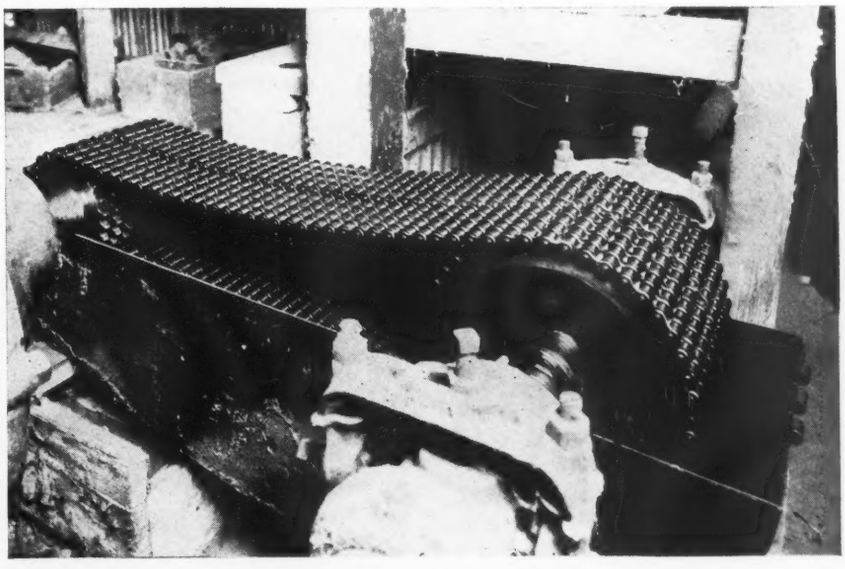
distance and 80 times is about maximum with normal chain speed, but much larger distances may be used for slow speed. For pulsating loads, center distance should be from 20 to 30 times chain pitch.

Although solid sprockets are most common, several other types are in use. Among these are split sprockets, for applications where it is impossible to use a solid design, and equalizing-spring sprockets. This latter type finds use where driving or driven unit has a pulsating action (internal-combustion engines or compressors with insufficient flywheel), or where coarse, cast gears may cause a hammering or whipping action in the chain. Shearing-pin sprockets can be used successfully when a protective device is needed to guard against sudden extreme overload and when machines may stall.

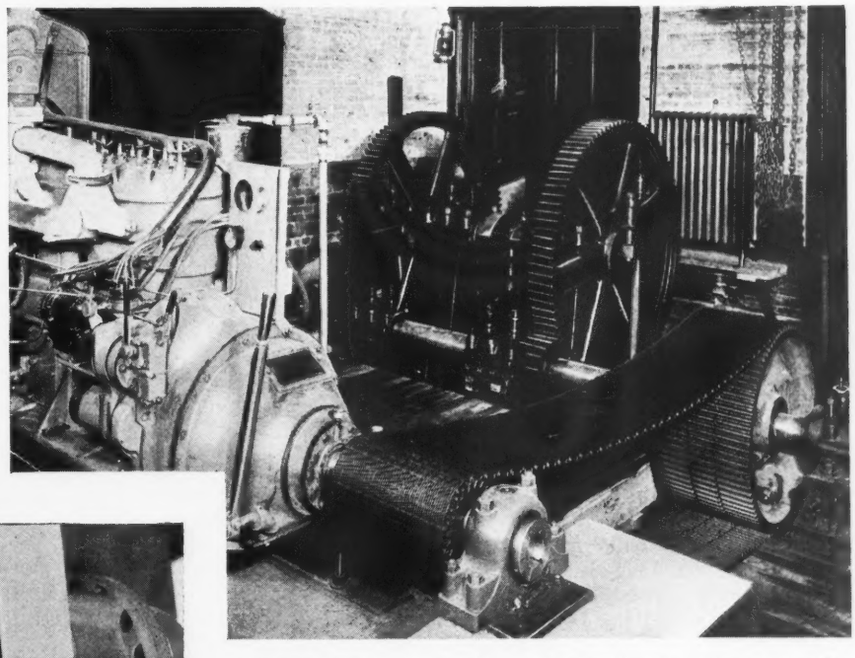
Speed ratios of 1:1 up to 7:1 are most desirable, but ratios up to 15:1 have been used. About 130 teeth is the maximum for the large sprocket and better results are generally obtained with a smaller number, particularly with smaller-pitch chains.

Chain drives have been built in sizes from fractional horsepower to 5000 hp. Although chain speeds up to 5000 fpm have been used, 1200 to 1500 fpm are most desirable. Above 1500 fpm, inclose chains to insure proper lubrication.

Chain manufacturers supply comprehensive data books, with which engineers concerned with this equipment should be familiar. When in doubt, consult the manufacturer and give complete data on the drive, including type, speed and capacity of power unit; kind of load to be driven, steady or pulsating, starting load and frequency of starting; speed of driven shaft, minimum and maximum center distances, maximum sizes of sprockets that can be used; sizes of driving and driven shafts and sizes of keyways; angle at which the chain will operate in reference to the horizontal, operating conditions such as hours per day, moisture, acid, dirt, etc; if there is a flywheel and whether it is on the driven or driving shaft. A simple diagram showing intended arrangement and principal dimensions will be helpful.



Here a double 4-strand finished-roller chain connects a 125-hp motor to a line shaft



Chain drives can handle pulsating loads. Here a 100-hp gas engine powers a plunger pump by a silent chain

A slow-speed belt conveyor driven by a 10-hp double-reduction gearmotor and a long-pitch roller chain. (left)

DMV Doesn't Mean Drink More Vodka

It does mean diaphragm-motor valves, which this and a subsequent article discuss in relation to control problems of industry

By E H HAMMOND

Chief Engineer, American S & B Instrument Div, Manning, Maxwell and Moore, Inc

ACCURATE automatic control of steam, gas, water and other liquids under a wide variety of conditions is a requirement of many industrial processes. For this work, several designs of diaphragm-motor valves are in use.

The term "diaphragm-motor valve" (dmv), or control valve, designates a valve actuated by fluid pressure applied to a flexible diaphragm, motion of which is opposed by a helical spring. Usually, the dmv is actuated by compressed air from a pilot-operated regulator, or an air-operated instrument controller. Primary function of the valve is to maintain a controlled condition at some predetermined value by regulating flow of a fluid according to demands of the controller. Ultimate behavior of the controller will depend largely on how consistently the dmv reacts to demands of the controller. For this reason, selection of the proper dmv is extremely important in problems of automatic control.

Design and Definition

A diaphragm-motor valve may be considered an adjustable orifice which is opened or closed by the controller. Fig. 1 shows a conventional construction, but individual designs and details will vary with different manufacturers. During recent years, there have been many improvements and advances in design and scope of these valves. Much has been done to eliminate friction in the superstructure, and to obtain uniform valve travel as a function of diaphragm pressure. The most notable advances, however, have been in the design and materials of the valve proper, and of the valve trim. By valve trim, I mean the movable valve disk or inner valve, and the valve seats or rings.

Diaphragm - motor - operated valves may be obtained with cast-iron or bronze bodies for lower temperatures and pressures, and with cast-steel bodies for the high-pressure ratings, including series 150 for 1500 lb and 750 F. Special air-cooled and lubricated packing glands can be obtained for temperatures up to 900 F and higher. Suitable valve trim can be selected for almost any service; for dead-end shut off, or lock up, at low and medium pressures, either single- or double-composition disks or single-seated metal-to-metal trim may be used. For other services, trim may be cast iron, bronze, monel, stainless steel, Fig. 2, or any suitable material which can be cast, machined, or ground to a suitable shape or form. Where erosion is serious, stellited

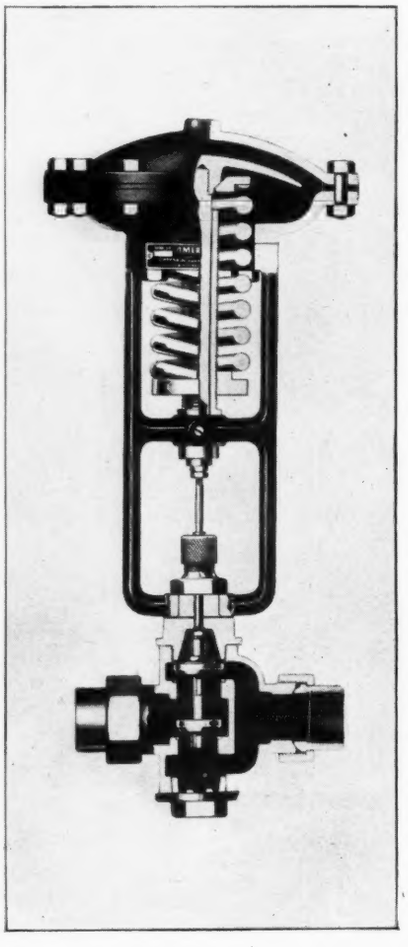


Fig. 1—Conventional diaphragm-motor-operated valve with exposed spring and quick-opening beveled double seat

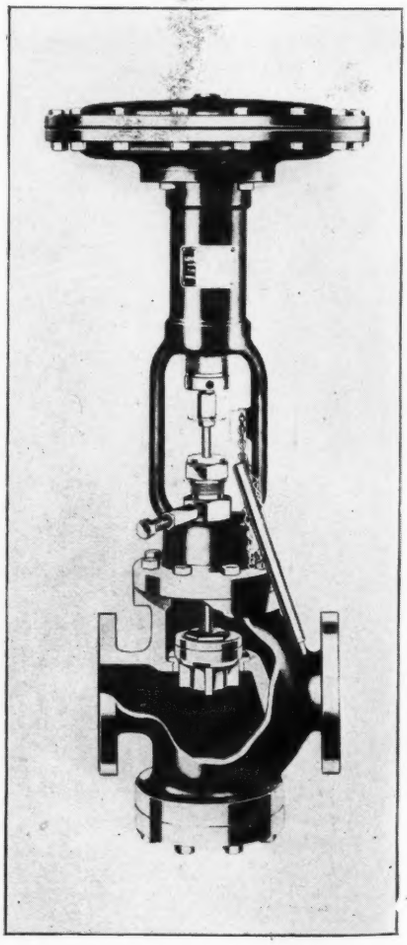


Fig. 2—Cast-iron body, single-seated, direct-acting diaphragm-motor valve with stainless-steel beveled single seat and disk

disks and seats find use; and stainless steel with a hardness factor as high as 500 Brinnell, Fig. 3, is being supplied for valve trim where both erosion and corrosion are bad.

For most industrial applications, the valve body will be of the conventional globe type, although angle-type bodies can be supplied. The valve may be either single seated as in Figs. 2 and 3, or double seated, Fig. 1, depending on service and particular requirements.

Diaphragm and Spring

Diaphragm diameter is determined by amount it must deflect (valve travel), friction of the packing gland, and off-balance load acting on the valve disk. The diaphragm spring provides an evenly graduated resistance to diaphragm travel and thus requires a definite change in pressure for a given valve travel. It is common practice to select a diaphragm and spring combination which will require a 15-lb change in diaphragm pressure to give full valve travel. The spring also provides a restoring force when the diaphragm pressure is reduced, to cause the valve disk to follow the diaphragm travel.

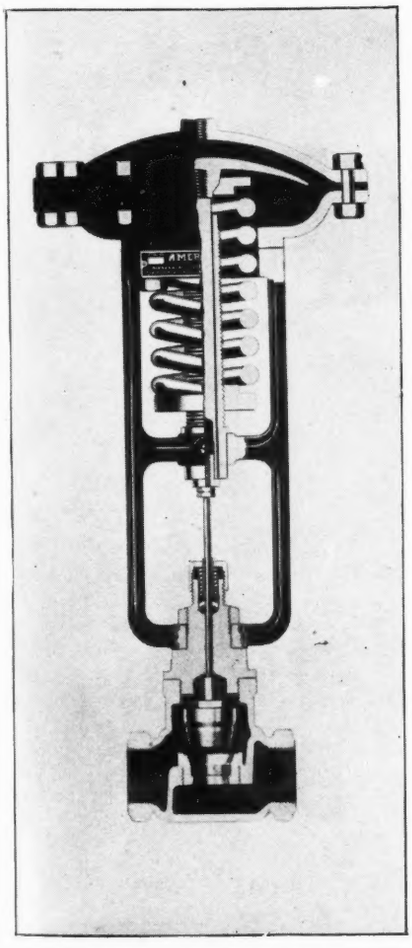


Fig. 3—Bronze-body, single-seated, direct-acting diaphragm-motor valve with 500-Brinell-stainless-steel cone seat and disk

Power of the diaphragm is absorbed by compressing the spring, by overcoming friction and effect of turbulence, and by resisting off-balance load thrust. Friction, turbulence, and off-balance load are usually variables. It is, therefore, desirable that the diaphragm have a large margin of power so that these changes will not cause unwanted valve movement or opening. This means that the diaphragm should be large with a correspondingly powerful spring. In general, the larger the diaphragm, the less effect friction and other unbalancing factors can have on valve operation.

Diaphragms are usually of natural or artificial rubber with duck or linen insert, or they may be molded to a predetermined shape to give maximum flexibility. The ordinary flat composition diaphragm must stretch as it deflects. This stretching, combined with the changing position of the diaphragm, decreases the effective area as travel increases. This means that a 1-lb pressure increase will travel the valve farther at the beginning of its stroke than near the end. The effect of this is shown in Fig. 4, in which effective area is plotted against travel. This decrease in effective area means that valve travel will not be proportional to diaphragm pressure throughout full stroke, but is not serious unless valve travel is too great, or valve flow characteristics do not match those of the diaphragm.

Precise Control

For precise control work, a large preformed diaphragm should be used to obtain a uniform or fairly constant effective area. This is especially true of large valves with graduated throttling action and consequent high lifts. Such a valve is shown in Fig. 6, and the diaphragm-travel characteristic in Fig. 5.

In a single-seated dmv, the diaphragm must have sufficient power to close the valve against the inlet or high-side pressure. Whether or not it will have this power will depend on the diaphragm area, the difference between the high-side and low-side pressures, and on the off-balanced load on the valve disk.

If pressure drop across the valve is constant, off-balanced load will be constant and merely equivalent to an additional spring load opposing diaphragm action. This is the case when a single-seated dmv controls steam flow at constant high-side pressure to mix with liquid in an open tank, low-side pressure being practically atmospheric, a condition seldom found in practice. Usually both high-side and low-side pressures vary with a change in valve opening. Turbulence and velocity effects also increase with flow.

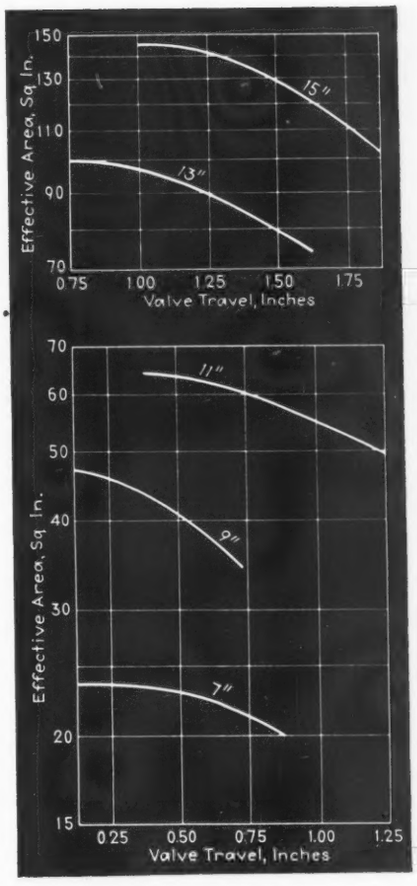


Fig. 4—Change in effective area of flat-rubber diaphragms at different positions of valve travel

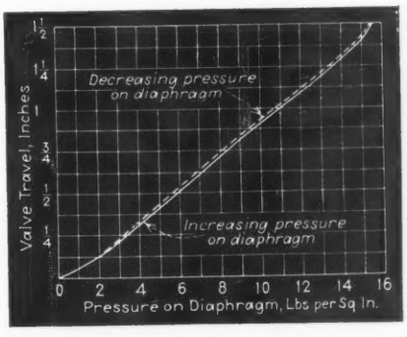


Fig. 5—Straight-line characteristics of large preformed rubber diaphragm

As an illustration, assume a single-seated valve with a port area of 2 sq in. and an effective diaphragm area of 50 sq in. For a certain flow through the valve, high-side pressure might be 200 lb and low-side pressure 100 lb, giving a pressure drop of 100 lb and an off-balanced load of $100 \times 2 = 200$ lb. Air pressure on the diaphragm required to just balance this off-balance load is $200 \div 50 = 4$ lb. For the assumed opening, total air pressure on the diaphragm might be

7 lb, of which 3 lb would be effective in positioning the valve and the other 4 lb would be required to overcome off-balance thrust on the valve disk.

Now suppose load changes so that the controlling instrument calls for a greater valve opening. As the valve opens, high-side pressure may drop, and low-side pressure increases. This decreases the differential pressure and produces exactly the same effect as though a lighter spring were suddenly placed in the valve. Air pressure already on the diaphragm opens the valve wider than it should, due to the sudden decrease in the off-balance thrust. Unfortunately, the controller does not know what is happening until after the control is upset. By this time, the control probably is surging badly, and it may take the controller some time to iron it out.

Because of these conditions, single-seated dmvs are limited by port area and by differential pressure. It is assumed, of course, that the diaphragm is as large as is practical from a manufacturing standpoint. The operating range of a single-seated dmv can be greatly increased, however, by adding a special valve positioner. Advantages of a single seated valve are tighter shut-off, smaller body size and weight, easier maintenance, and smaller superstructure.

Capacity

Double-ported valves were designed to eliminate off-balance effect found in single-seated valves, and to provide larger flow capacity for the same nominal size. The capacity of a given size dmv is determined by the maximum flow which it can pass under specified operating conditions. This capacity is a function of the valve-flow characteristics and therefore, a measure of the cost of regulation per unit volume of flow. Capacity for any nominal valve size is an important economic factor, and dmvs should be purchased with a definite guarantee as to both capacity and regulation.

To meet increasing demands for better regulation and increased capacity, new designs having large capacity and a minimum of body turbulence and internal friction have been developed. Need for increased capacity and better regulation, and more severe service requirements imposed by higher temperatures and pressures, have led naturally to balanced, double-ported, high-lift valves, Figs. 7 and 8.

By using a double disk on the same valve stem—one disk seating on the low-pressure and the other on the high-pressure side of the bridge—unbalanced area is almost eliminated. A high-pressure drop across even a large valve will therefore not cause any appreciable thrust on the valve stem. In addition, the double-seated construction permits a much higher capacity, partly because of the extra port, and partly from better streamlining which the larger valve permits.

Photographs, Figs. 2 and 7 are Fisher Governor Co; Fig. 8, Mason Neilan Regulator Co; and Figs. 1, 3 and 6, American S & B Instrument Div, Manning, Maxwell & Moore, Inc.

Fear not that thy life shall come to an end, but rather fear that it shall never have a beginning.—Cardinal Newman.

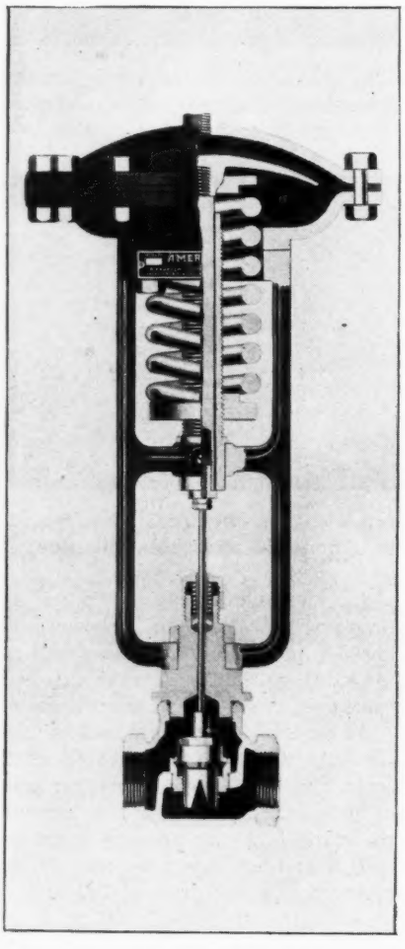


Fig. 6—Single-seated, V-port diaphragm-motor valve for accurate throttling action over a wide range of flow

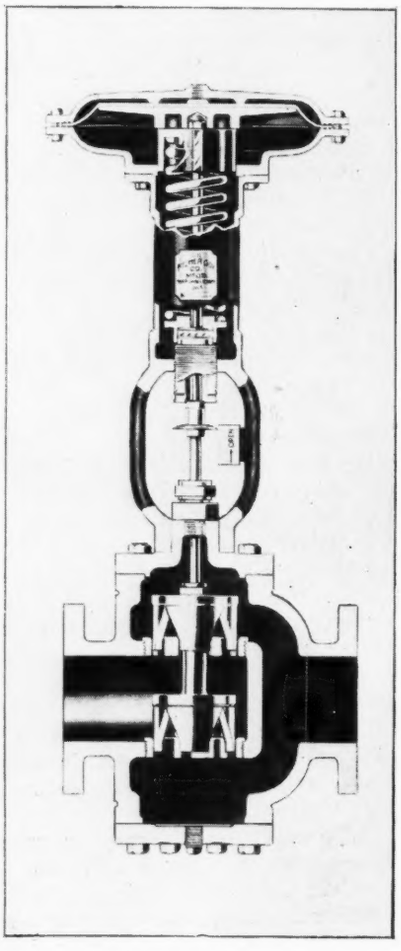


Fig. 7—High-lift, direct-acting, double-seated diaphragm-motor valve with throttling V-port and preformed diaphragm

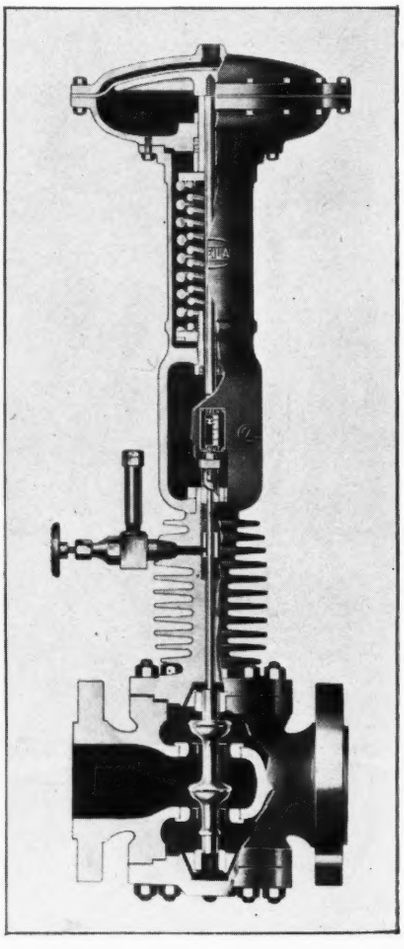


Fig. 8—Gradual opening, direct-acting, diaphragm-motor valve with parabolic valve plug, grease seal and air-cooled stuffing box

The Human Voltmeter

An old-time trouble shooter recalls the days when voltmeters were mighty peculiar beasts — they could talk 'n everything

By N L REA
Supt Electrical Installations, General Electric Co

WHEN BEN FRANKLIN stood out in the rain and pulled sparks from the Pennsylvania skies, he knew he had something. A jolt that nearly floored him told him so, which was finding out the hard way. Today we have all kinds of instruments and devices to tell us what we want to know, and it is hard to appreciate

Explaining the Trouble

handicaps faced by pioneers in the lighting industry 40 or 50 years ago.

Things we consider necessities and take for granted were then unknown or unavailable. Owners and operators of lighting plants did the best they could, but often they hardly knew what it was all about.

Perhaps the tale told by one of the early trouble shooters will show the contrast with things as they are today. It went something like this:

"My boss told me to go to a large Southern city immediately, if not sooner, as a telegram hinted (in no uncertain terms) of a serious trouble that couldn't be explained or corrected. I arrived early next morning and noticed that lamps in the railway station were very dim, in fact, just red. It was daylight when I reached the street, so I took time out for a bite of breakfast, as plants shut down soon after sunrise in those days.

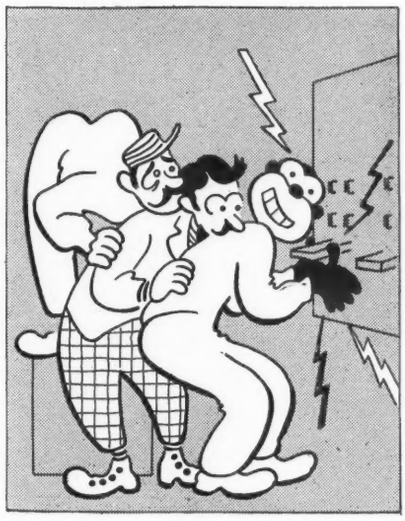
"Proceeding to the power house, I found two engine-driven bipolars connected to a 3-wire system. The switchboard was a simple wooden frame carrying the busses and crude switches. No voltmeters or ammeters, simply pilot lights on each generator.

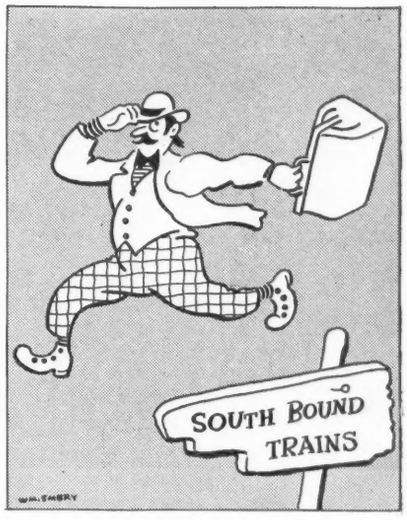
Customers Were Kicking

"The superintendent said that things were apparently all right in the station—machines operating normally and pilot lights burning brightly. However, the lights were dim, or just red, out on the feeders. His customers were kicking and he was unable to find the trouble.

I showed him where the neutral

No Voltmeter Needed





Dashing South

cables had been hot enough to start the tar dripping from the covering and explained how one generator had reversed its polarity, thus putting the two machines in parallel. This, of course, caused the neutral to carry the entire current of both generators, instead of solely the unbalanced current. I then showed him how to flash the field of one generator to reverse polarity.

"He said, 'I won't get caught again. I knew there was something wrong and I wasn't getting enough voltage across the mains, but didn't know what it meant.'

"I asked him how he knew that when he didn't have a voltmeter.

"'I don't need a voltmeter,' he said. 'Hey, Sam! Come here!'

"Sam appeared, a big negro fireman.

"'How is it tonight, Sam?'

"Sam licked his fingers and put them on the main fuses.

"'Sho' hot today, Boss! Las' night wa'nt nuffin'!'"

A NOVEL source of condenser cooling water is going to be used by the new Bluffton generating plant of Central Ohio Power & Light Co. The power company is driving a 370-ft tunnel through solid rock down into the quarry of the National Lime & Stone Co. This tunnel will be divided lengthwise by a wall, making it serve as both inlet and outlet.

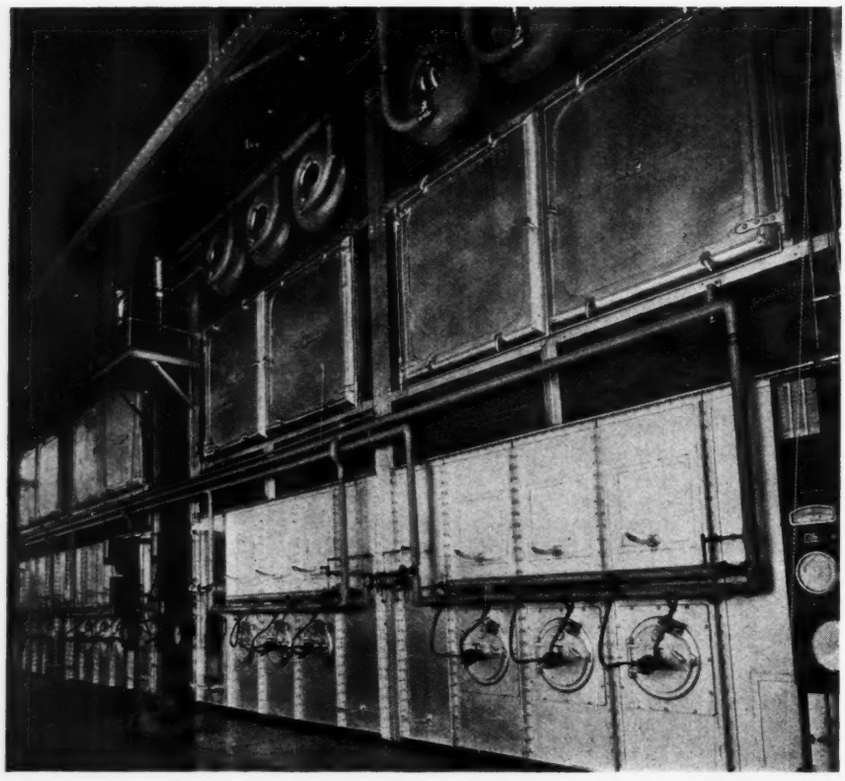


Fig. 1—Aluminum paint and cleanliness make for a light, spacious atmosphere in this boiler room

Five-Year Plan For Cheaper Power

Modernization increases economy and reliability at Woburn plant of Consolidated Chemical Industries, Inc

A CONTINUOUS program of modernization has been going on in the power plant of Consolidated Chemical Industries, at Woburn, Mass., ever since it was taken over from the original owners in 1933. New firing equipment and improved boiler settings have contributed to making cheaper steam and savings in power generation have been effected by turbine-room changes, notably the addition of a new 800-kw Terry backpressure unit. Hand-in-hand with these major developments, a host of minor improvements in equipment and operating methods have been made. Net results are more economical production of power services and assured reliability of operation.

Modernization began in the boiler room, and in December 1933 two of the stoker-fired boilers, installed in 1914, started operation after conversion to oil firing. New settings, with water-cooled walls, were provided and all tubes and nipples were replaced. In 1934, another boiler was converted in similar fashion, and the last unit was swung over to oil in 1935. Settings were installed by Frank E Ross Co and Hodge Boiler Works made the boiler replacements.

Boiler Room

To one of the editors of *Power,* who visited the plant in February, the light, spacious boiler room presented a picture of modern industrial-power practice. The four Babcock & Wilcox 3-drum, straight-tube boilers are set in batteries of two. Drums are 42 in. in diameter and 21 ft, 10 in. long. Heating surface comprises 250 4-in. tubes, and each boiler is equipped with a Foster superheater. The air-cooled settings, which have permitted carrying higher ratings, are of the American Arch Co's type. A 220-ft high concrete stack, 9 ft in diameter at the top and 25 ft at the base, is set on its own foundation outside of the boiler house. No mechanical draft is required. Each boiler has an instrument panel mounting a Brown steam flowmeter, a Ranarex CO_2 recorder, and Ellison draft gages. Average output from three boilers is 2,000,000 lb of steam at 200 lb, 125 F superheat, every 24 hours.

Firing equipment is three Peabody burners per boiler. The Bunker C oil burned is supplied by rail and stored in three 30,000-gal. underground storage tanks. Each tank is equipped with steam heating coils, connected to a 100-lb steam line. A common header

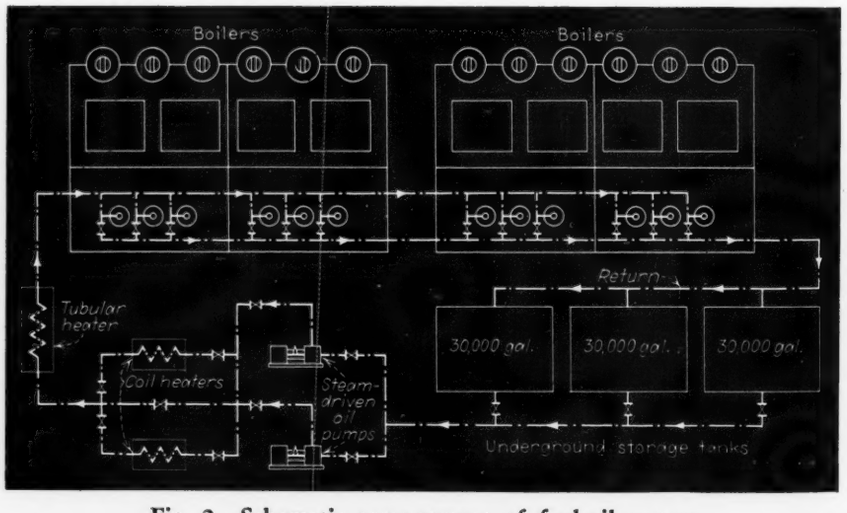


Fig. 2—Schematic arrangement of fuel-oil system

ties the three tanks to two Worthington duplex, 6x4x6 in., steam-driven fuel-oil pumps. Discharge-piping interconnections are such that either pump can serve either of two coil heaters, supplied with 5-lb steam. A tubular heater using 100-lb steam in small quantities, regulates the final temperature of the oil. All burners are fed by a common header, and each is equipped with a bypass connection so that under light loads, excess oil can be returned to the storage tanks. The fuel-oil system is illustrated schematically in Fig. 2.

Turbine-Generators

Power is generated in three turbine-generator sets with an aggregate capacity of approximately 2000 kw. Two of these units, a 500-kw General Electric and a 625-kw Westinghouse, were installed by the original owners in 1914. The third, an 800-kw Terry, was put in service in 1937. The smallest member of this turbine trio is a 3600-rpm Curtis turbine exhausting to a Wheeler jet condenser, and direct-connected to a 3-phase, 60-cycle, 480-volt generator. Similar at the electrical end, the Westinghouse machine is designed for extraction at from 40 to 60 lb, and is fitted with a Westinghouse jet condenser. Normal operation, before advent of the new turbine, was to load the bleeder unit as heavily as demand for process steam would permit and to supply power loads over that by operation of the straight-condensing unit. Excitation for these machines is provided by a separate exciter which can be driven by either steam turbine or motor.

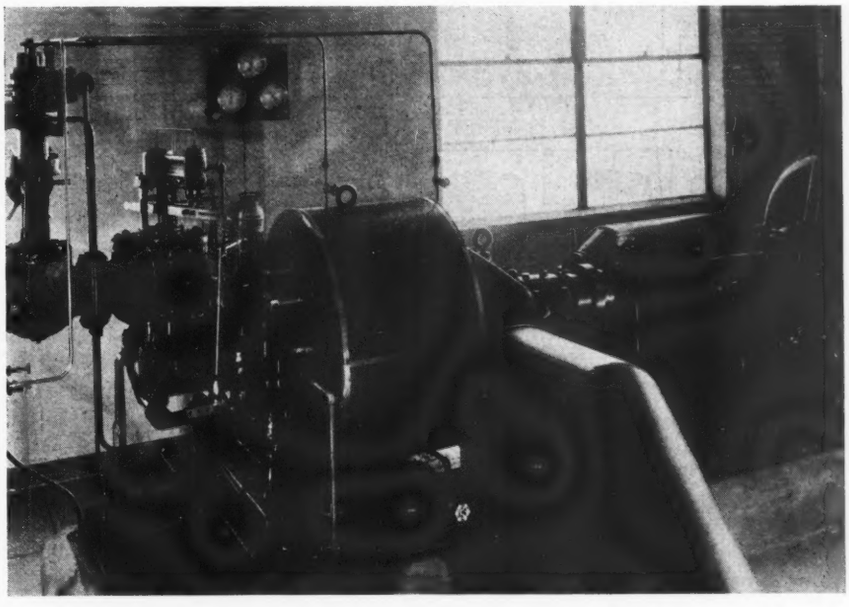
Growing power and process loads made the provision of additional capacity both necessary and economically attractive. Selection of a backpressure unit offered several advantages. No condenser was required and a maximum of process steam at 40 lb was obtained for any given electrical load. The machine chosen, a Terry turbine, operates at 3750 rpm and drives, through a reduction gear, a 1200-rpm, GE generator and exciter. At full load, 49.5 lb of steam, expanding from 200 lb to 40 lb, makes one kwhr.

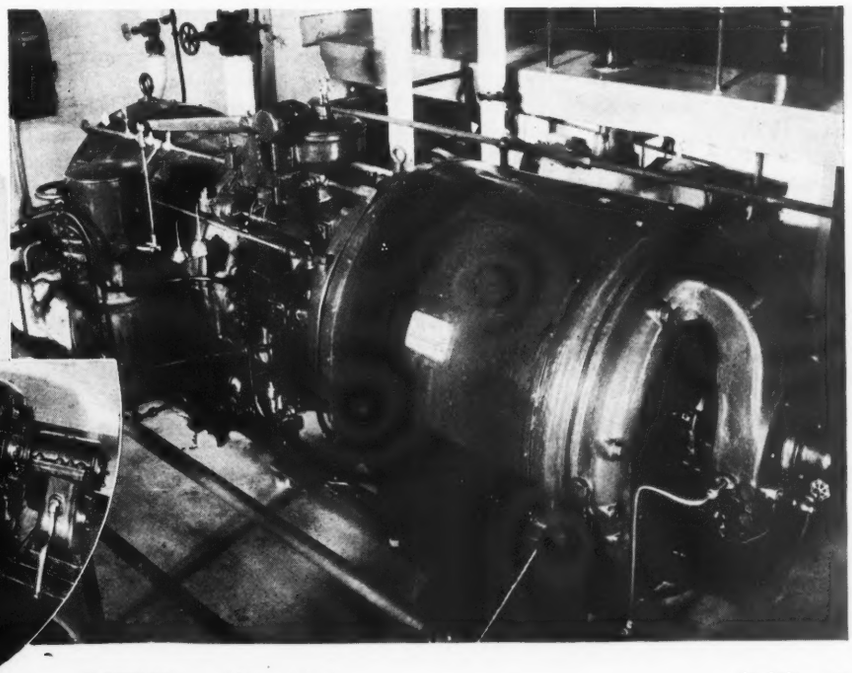
Electric Load

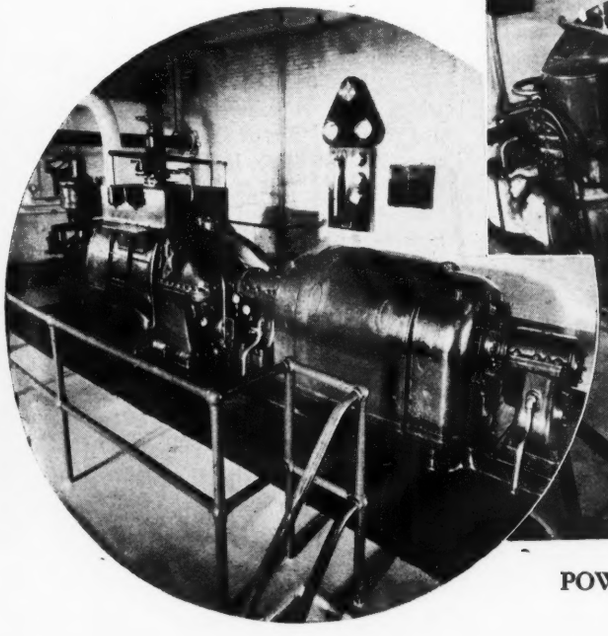
Now, normal operation is to carry process steam load on either back-pressure or bleeder turbine, depending on conditions, generating as much byproduct power as possible. Additional electric load requirements are met by the straight-condensing turbine. Since electrical load averages 1200 kw, ample reserve capacity is available to permit shutting down any single generator without losing load.

High-pressure steam is also supplied to a turbine-driven Carrier centrifugal compressor (100 tons capacity), which chills brine for circulation to glue-congealing cabinets in the mill building. Outgoing brine temperature is about 0 F, and return is at about 4 F.

The flow diagram, Fig. 6, shows the relation of major steam-using units, and the low-pressure steam and water circuits. All 40-lb steam goes to the mill to meet process requirements and building-heating demand. The compressor turbine, the exciter turbine, and all steam-driven pumps exhaust into a 5-lb system which is tapped for power-house heating, fuel-oil heating, service-water and feedwater heating. A reducing valve provides 100-lb steam for a fire pump and for heating oil in the underground storage tanks. An-







Figs. 3, 4 and 5—Turbine trio: new backpressure unit, above; straight-condensing turbine, below; and extraction-condensing unit, lower left

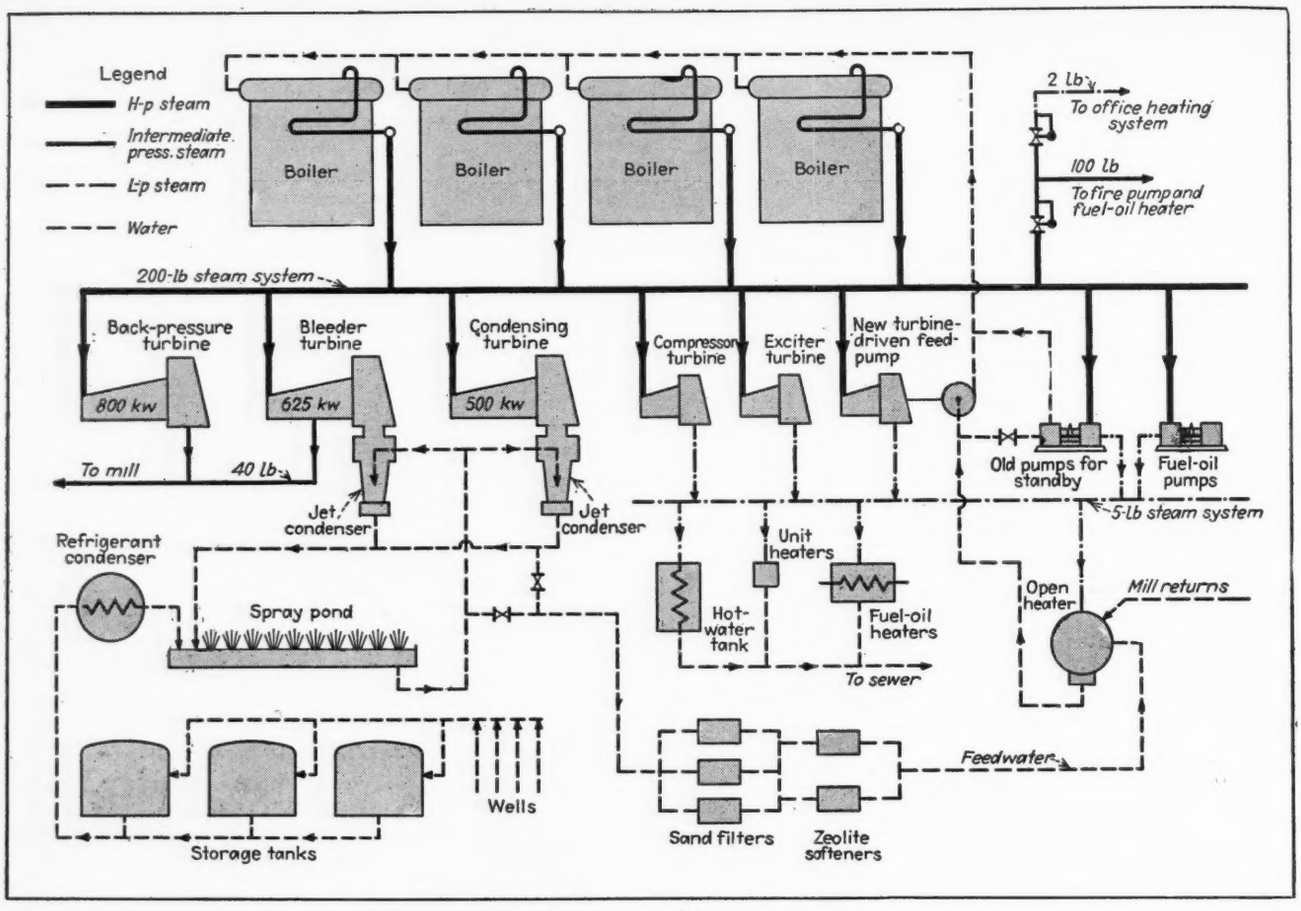


Fig. 6—General flow diagram

other reducer is utilized to get 2-lb steam for office heating.

Much of the modernization work has centered in the cooling-water and feedwater circuits. Water at temperatures averaging 52 F, winter and summer, is lifted by electrically-driven Fairbanks-Morse deep-well pumps from wells. There are three storage tanks, from which well water flows to the refrigerant condenser of the Carrier unit, an arrangement made desirable by the low water temperatures. Refrigerant-condenser discharge passes to the spray pond that supplies the steam-condenser jets. In winter months, condensate is used directly as boiler feed, but in summer all condensate returns to the spray pond for cooling, and boiler feed is drawn from the pond. This arrangement is necessary to avoid passing water at high temperature through the zeolite softeners, the limit being about 100 F.

Feedwater

Former troubles with boiler scale have been eliminated by constantly improving the method of treating the water, which runs about 12 grains hard. First step is through three sand filters, installed in 1935, from which it passes to two zeolite softeners, dating from 1934. Formerly these units were hand controlled, but improved operation has resulted from the addition, in 1937, of the Permutit system of automatic control. Each time 24,000 gal. of water passes a metering switch, electrically-operated valves start the backwashing process, lasting 10 minutes. This is followed, under control of a Telechron-regulated program switch, by the reactivating cycle, consisting of 3 minutes of brine and 20 minutes of brine washing, after which normal operation is resumed. An after-treatment of disodium phosphate gives water with practically no hardness.

Brine for activation (about 24.6 deg. Baumé) is prepared automatically by the Lixate process of the International Salt Company. Salt fed from a hopper dissolves in water and passes into a bed of salt which acts as a filter and also insures 100% brine. Flow of brine from the preparation unit to its storage tank is regulated at about 60 gal. per hr. The Lixate process produces an improved brine, and permits the use of rock salt, effecting a saving of about 200 lb per day.

Feedwater is now heated in an open heater, but it is hoped to replace this with a deaerating heater in the near future. Another example of the savings to be made by a sound program of modernization is represented by a change in feedwater-pumping equipment just completed. Formerly, two duplex pumps, 14x8½x15 in., supplied the boilers. A new unit, consisting of a 90-hp Terry turbine direct-connected to a 525-gpm Worthington centrifugal pump, meets the same requirements with less than half the steam. The old pumps are being held as standbys. Feed-pump governors are Swartwout, as are the feedwater regulators controlling flow to the boilers. Another contemplated improvement is substitution of a continuous blowdown system, with heat exchanger, for the present conventional arrangement.

No More Scale Troubles

Former scale troubles were partly due to contamination of mill returns, which has been eliminated by a rigorous rehabilitation of the process equipment to eliminate leaks. This action and improved water treatment have virtually eliminated scaling. Boilers now carry higher ratings without tube failures; where formerly all four boilers were needed to handle peak loads, now three can do the job, leaving one in reserve, a valuable feature in a plant serving a continuous process where loss of steam or power would be costly.

Data on this plant were gathered by one of the editors with the cooperation of the management of Consolidated Chemical Industries, Inc.

Water Guard

Engineering skill maintained water service above 84th floor of Empire State Bldg while storage tank was being cleaned and resurfaced

By CHARLES F WENDLAND
Chief Engineer, Empire State Bldg

THE EMPIRE STATE Bldg, being the tallest building in the world, is down on all the record books. The engineering department, however, is more interested in maintaining an enviable record of servicing this mammoth 102-story structure. One of our most important concerns is water supply, and every effort is made to keep it pure from the time water comes in the building to consumption.

Modern water tanks are spaced throughout the building. Water is pumped to these tanks, from which it flows down distribution lines to the services on various floors. All tanks are in duplicate except the one on the 102nd floor. Recently, when we decided to clean and resurface all tanks with a special protective coating, we had to remove water from each tank for about four days. In this connection, it may be interesting to know that New York City water, while very palatable and soft, is high in oxygen content and therefore severe on metals.

Special Hookup

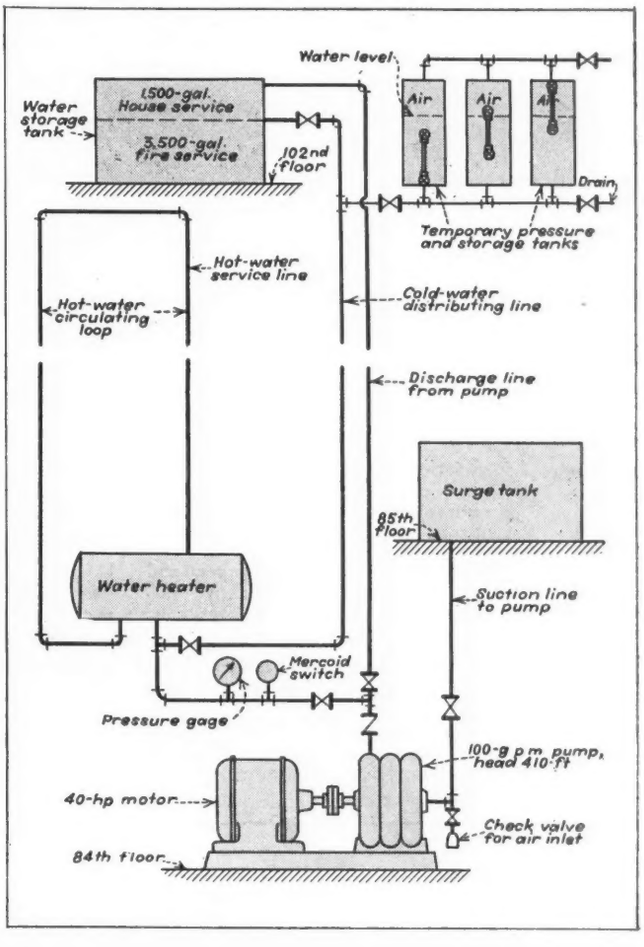
To clean and treat each pair of duplicate tanks was only a matter of taking one out of use while the other maintained service. However, the 5000-gal. tower tank, which has 3500 gal. in the bottom for fire protection and 1500 gal. above for house service, required special work to make it available for cleaning (see diagram). Three 66-gal. standard domestic hot-water tanks were connected into the cold-water distribution line on the 102nd floor. Each tank was equipped with a gage glass, about one-third the length of a tank, and arranged so that the three glasses covered the full length of the tanks. As these tanks provided storage and expansion capacity on the system, gage glasses were essential to show amount of water and air.

Water, pumped from a basement surge tank to a tank on the 85th floor, flows to the intake of a booster pump on the 84th floor, from which it discharges into the tower tank. On the 84th floor near the pump is a water heater serving the floors above. A cold-water line leading down from the 102nd to the 84th floor connects to the bottom of the heater.

From the junction of this line with the heater, we made a connection between check and gate valves on the pump-discharge line, on which we installed a pressure gage and mercoid pressure switch, the latter set to close at 80 lb and open at 135 lb. Mercoid-switch contacts were connected in parallel with the control-panel float switch, which permitted us to control the pump by mercoid switch when float switch was taken off. A check valve, put in the suction line, permitted air leakage, if necessary, into the pump to maintain air charge in the storage-pressure tanks. A bleed valve on these tanks is provided to drain excess air. After correct operating conditions were once established, the air-water-volume relation remained practically constant without any attention.

When everything was ready, the float switch was cut out and valves in the storage-tank and pump-discharge lines were closed. Valves between distribution line and pressure tanks, and between pump discharge and water heater, were opened. We then started the pump by the mercoid switch to bring pressure up to 135 lb, at which point the mercoid switch opened. To keep pressure from coming up too rapidly, the suction-line valve was throttled. This would keep the pump operating about 5 min to return pressure to 135 lb after it had dropped to 80 lb. .

The diagram shows path of water up the cold-water distribution line to the various floors and storage-pressure tanks. This arrangement maintained water service satisfactorily for almost a week while the storage tank was being cleaned and treated. Everything worked so well that we have decided to make this emergency equipment a permanent part of the water system and maintain it in condition for possible immediate use.



Line with mercoid switch and pressure - storage tanks, installed to maintain water service while storage tank was being cleaned and treated

From Squirt-Can to Automatic Lubrication

This, the first of a series on oiling systems and devices, shows applications, and discusses hand oiling

By JAMES I CLOWER

Associate Professor of Machine Design, Virginia Polytechnic Institute

TABLE I—TYPES OF OILING SYSTEMS

System	*Type of Service*	*Characteristics*
Hand oiling	Low-speed bearings, open gears, chains, wire rope, hoists, farm machinery, and other relatively cheap and rough machinery	Non-automatic, unreliable, inefficient and irregular, cost low but maintenance cost usually high
Drop-feed oiling	Plain and anti-friction bearings, chains, gears, etc. Commonly used on steam engines, air and refrigerating compressors, internal-combustion engines, machine tools, etc.	Usually non-automatic, unreliable, irregular, inefficient, adjustable to a certain degree, relatively cheap
Wick-feed oiling	Paper mills, rubber mills, cement mills, woodworking plants, ceramic machinery, railway-truck axles, small electric motors, general bearings, etc.	Non-automatic, except the bottom-feed type, irregular, reliable, adjustable, moderately efficient and relatively cheap
Bottle oiling	Plain horizontal bearings of small and medium size machine tools, shaft bearings of cotton, silk, rayon and woolen mills; conveyor-shaft bearings, blowers, electric motors, etc.	Automatic, adjustable, reliable, and moderately efficient. Relatively cheap, limited application
Ring, chain, and collar oiling	Electric motors, fans, blowers, centrifugal and rotary pumps, steam engines, compressors, line-shaft bearings, etc.	Automatic, reliable, efficient, not suitable for very low and high speed bearings. Only applicable to horizontal bearings
Bath oiling	Enclosed gears, chains, wire ropes, plain and anti-friction bearings, thrust bearings, etc.	Automatic, reliable, efficient, regular, limited application, requires oil-tight housing, first cost high
Splash oiling	Bearings grouped in oil-tight housing, enclosed gears of all types, internal-combustion engines, compressors, steam engines, etc.	Automatic, efficient, reliable, regular, if oil is kept at correct level, requires high-grade oil, first cost high
Centralized oiling	Machine tools; steel, paper and rubber mills; woodworking machinery, etc.	Generally, automatic and positive. May be built integral with machine. First cost relatively high
Circulating oiling	High-speed, heavily loaded bearings, high-grade gearing of all types, machine tools; steel, rubber, and textile mills; paper-mill machinery. Steam turbines, engines, compressors, fans, blowers, etc.	Usually automatic, reliable, adjustable, efficient, wide range of application. Usually complex and first cost high

LUBRICATION, being the life blood of every machine, is one of the most important factors in machinery operation. The multitude of devices and systems that have been developed may be divided into two general groups: greasing equipment and oiling systems. Grease lubrication was covered by articles in October and November, 1937, and January and March 1938, *Power*. This is the first of a series of articles on devices for applying oil as a lubricant.

Oiling appliances and systems are of many and varied designs, but for discussion are classified in Tables I and II. In Table I, the term automatic means that the lubrication system starts and stops feeding oil to the bearing as the machine starts and stops. Non-automatic means that it is necessary to start and stop the appliance or system independent of the machine. Only appliances and system in which oil is used over and over are considered efficient.

Systems and appliances in which oil-level and temperature variations cause an appreciable change in the rate of feed are not considered regular-feed devices. Hand and drop-feed oiling are not considered reliable because of the human element involved in the former and the tendency of the drop-feed needle valve to become clogged.

Positive Systems

Positive systems feed by other than gravity and capillary action of a wick. In general, systems in which an appreciable pressure is produced by some mechanical device, such as a pump, will force out dirt and any other obstruction that may become lodged in line, regulating valves, etc.

Undoubtedly, the oldest method of oiling bearings is by a hand oiler, two designs of which are shown in Figs. 1 and 2. In the push-bottom type, Fig. 1, oil flow from the oiler is accelerated by depressing the spring-like bottom. This oiler, which has to be held with the spout vertically

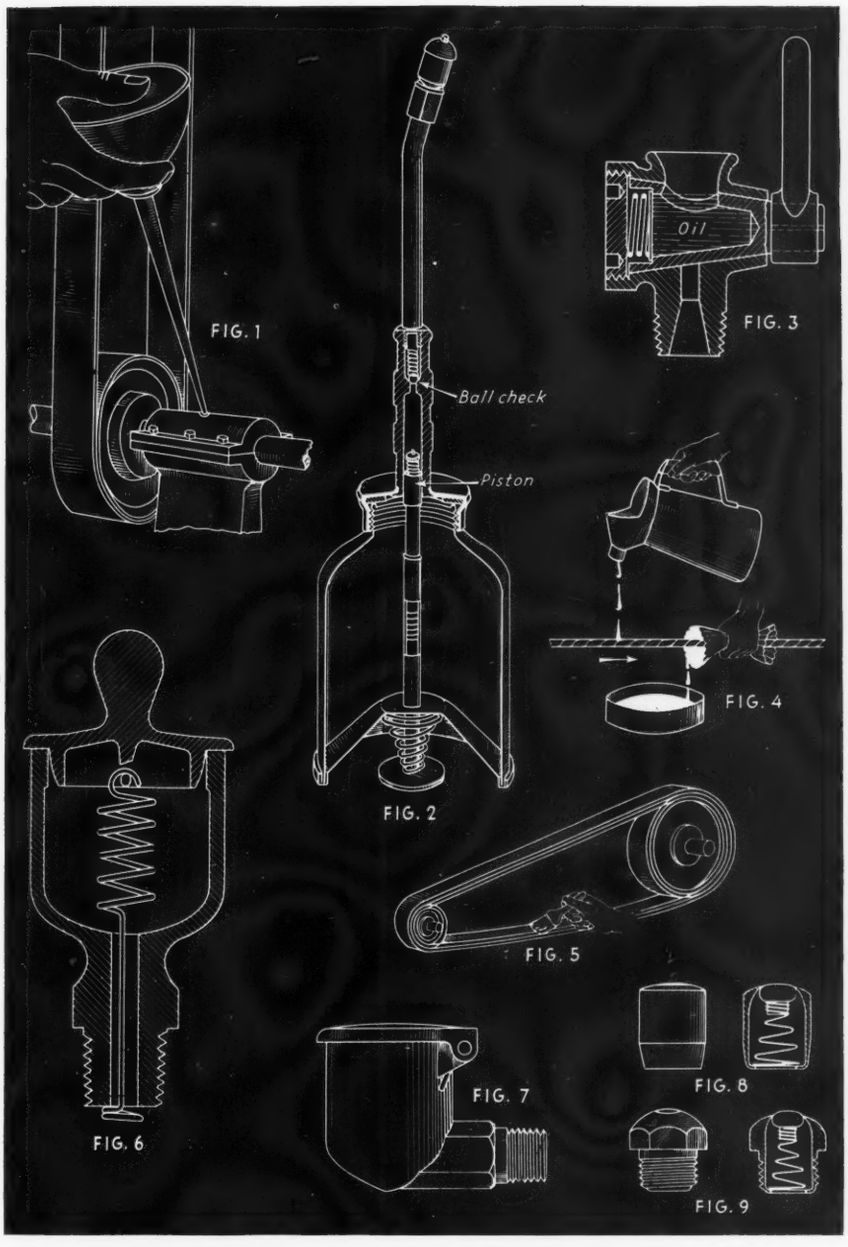


Fig. 1—Push-bottom oil can. Fig. 2—Oil can with inclosed push-button pump. Fig. 3—Cup oiler for air-operated tools. Fig. 4—Hand oiling a horizontal wire rope. Fig. 5—Hand oiling a silent- or roller-chain drive with a brush and oil or grease. Fig. 6—Vertical oil cup with cover held in place by spiral spring. Fig. 7—Right-angle oil cup with spring cover. Figs. 8 and 9—Ball valve covers for oil holes on small bearings

downward or nearly so, is not positive. If dirt obstructs flow through the spout or if oil is very viscous, little if any will flow out. Fig. 2, an improved design with inclosed thumb-operated pump in which considerable pressure can be exerted to force oil out of the spout, is more positive and quick-acting.

A hand cup oiler, Fig. 3, is especially designed for air-operated tools. This oiler, attached by means of a T-fitting to the air line close to the tool, affords a means of measuring amount of oil introduced into the tool.

Hand oiling of a horizontal wire rope is shown in Fig. 4. In general, it is advisable to run the rope through a swab after oil has been applied, thereby working oil into the interior of the rope, where it is most needed.

Oiling Roller Chains

Silent or roller chains can be oiled by a brush, Fig. 5. Both sides of the chain should be oiled. This method is not recommended for high speeds, for chains transmitting large horsepower, or if the drive is in dirty, dusty surroundings.

There are many covering and closing devices, such as those in Figs. 6-9, to prevent dirt and dust from entering bearing oil holes. These covers are made in a wide variety of designs and shapes and of various materials, steel being most commonly used and brass next. Some have a rather large reservoir into which cotton or wool waste is packed and saturated with oil, thereby providing a small reserve supply of oil which feeds more or less regularly to the bearing over a limited period of time.

Hand-oiled bearings and other machine parts are nearly always over or under lubricated. The first condition causes waste of oil and messy appearance as well as a fire hazard; under lubrication is a source of excessive wear, friction, and overheating. Continuous and perfect lubrication is practically imposible with hand oiling and is unsatisfactory unless regular and close attention is given by the oiler.

TABLE II
LUBRICATING APPLIANCES

1. **Hand-Operated Squirt Oilers**
   - a { push bottom / enclosed pump
2. **Drop-Feed Oilers**
   - a { single feed / multiple feed
   - b { variable level / constant level
   - c { hand operated / automatically operated
3. **Wick-Feed Oilers**
   - a { single feed / multiple feed
   - b { variable level / constant level
4. **Manually or Hand-Operated Oilers**
5. **Hydrostatic Lubricators**
   - a { single connection / double connection
6. **Bottle Oilers**
   - a { globe body / flat-side body
7. **Ring, Chain and Collar Oilers**
8. **Mechanical Force-Feed Oilers**
   - a { ratchet driven / rotary driven / motor driven
   - b { single feed / multiple feed
9. **Centralized Appliances**
   - a { single-line systems / multiple-line systems
   - b { oil systems / grease systems
10. **Oil Pumps**
    - a { gear / rotary / centrifugal / plunger
11. **Special Appliances for:**
    - air-operated tools
    - silent and roller chains
    - railroad equipment
    - wire ropes

Vienna Stores 1700-lb Steam

With its sensationally high pressure, unique drum construction, 1-tube charging boiler, and other special features, the steam-storage installation here described is unlike any existing in America*

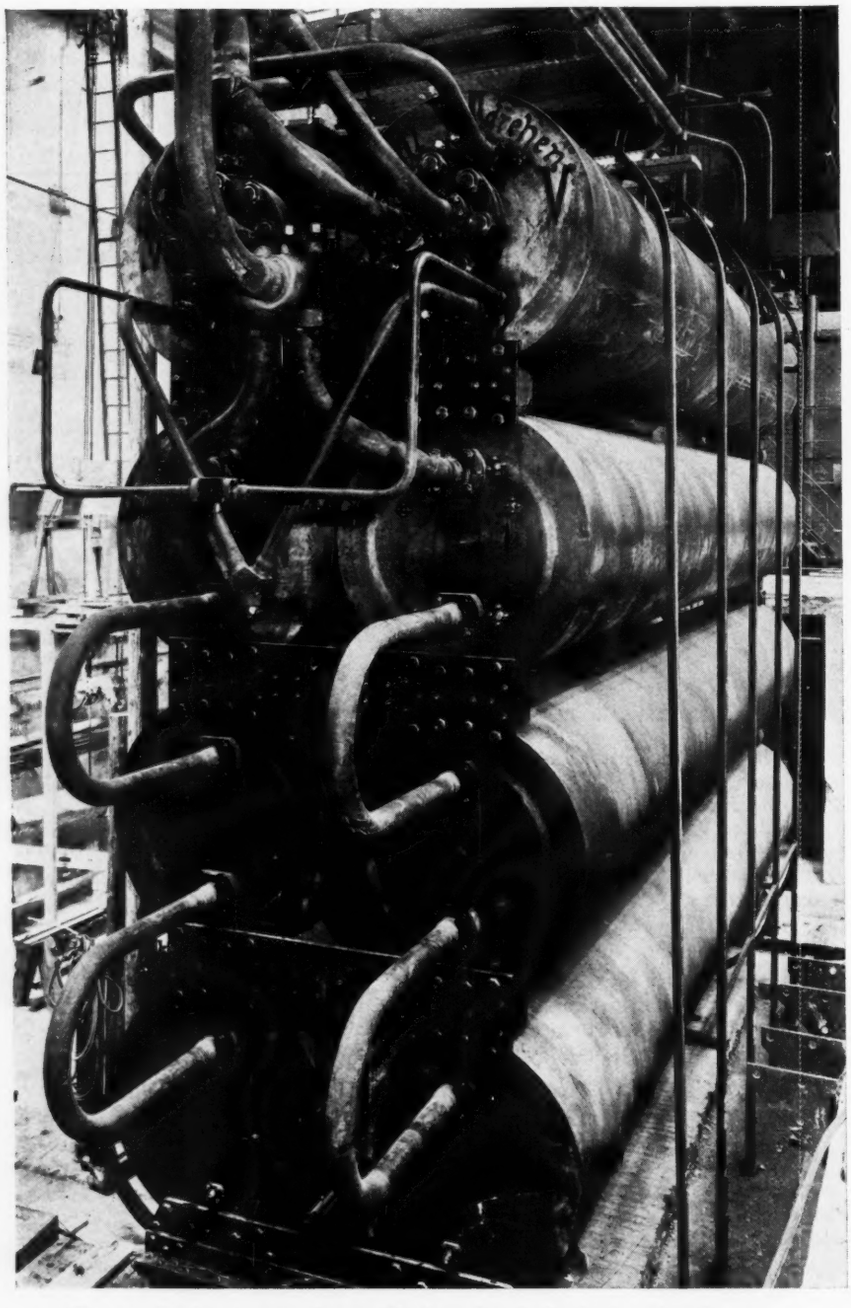


Fig. 1—Eight storage drums (before insulating) showing interconnections. Nos. 1-2 (top layer) are "superheating accumulator". Nos. 3-4, 5-6, and 7-8 (three lower pairs) are "main accumulator"

SIMMERING power station, Vienna, Austria, has installed the world's first 1700-lb pressure accumulator, constructed by the Wiener Lokomotiv Fabriks AG in Vienna, according to their own patents and that of Ruths International Accumulators, Inc, in association with the Electrical Works of Vienna.

Hydro stations furnish the principal electrical supply of Vienna; the two steam plants in the city supply only 10 to 20% of the demand. Serving as standby stations, these must take loads up to 40,000 kw in a few seconds. Simmering, in particular, must keep turbines on the line at all times to pick up unexpected loads. This explains the high-pressure-steam accumulator and a special quick-starting boiler.

The accumulator has a capacity of 27,500 lb of steam over a pressure range from 1700 to 500 lb. Final temperature of stored steam varies from 570 F at beginning of discharge to 475 F at the end. In the first four minutes, the accumulator can deliver 4400 lb of steam per min. It consists of eight storage drums arranged in four pairs, one pair above another. Internal diameter is 39.3 in., wall thickness 2.83 in., length 30 ft.

Drums

Vitkovice steel works (Czechoslovakia) forged the drums from single ingots. Inner and outer surfaces were machined and ends closed with flat disks about 1 ft thick, screwed in and seal welded. To avoid openings in drum walls, all piping connections and manholes are in the end plates.

The two highest drums (1 and 2), called the "superheater accumulator," are inter-connected on water and steam sides. The remaining drums (3-4, 5-6, 7-8) constitute the "main accumulator." During both charging and discharging, saturated steam is delivered from the steam side of the superheater accumulator to the lowest pair of drums (7-8). Thence it flows first through 5-6 and then to 3-4. The main accumulator delivers saturated steam

* Abstract of a paper by Dr Ing Franz Stipernitz, originally published in Feb, 1938, number of *The Steam Engineer*, London. John Troup, managing director of that publication, has kindly supplied us with photograph and drawing here reproduced.

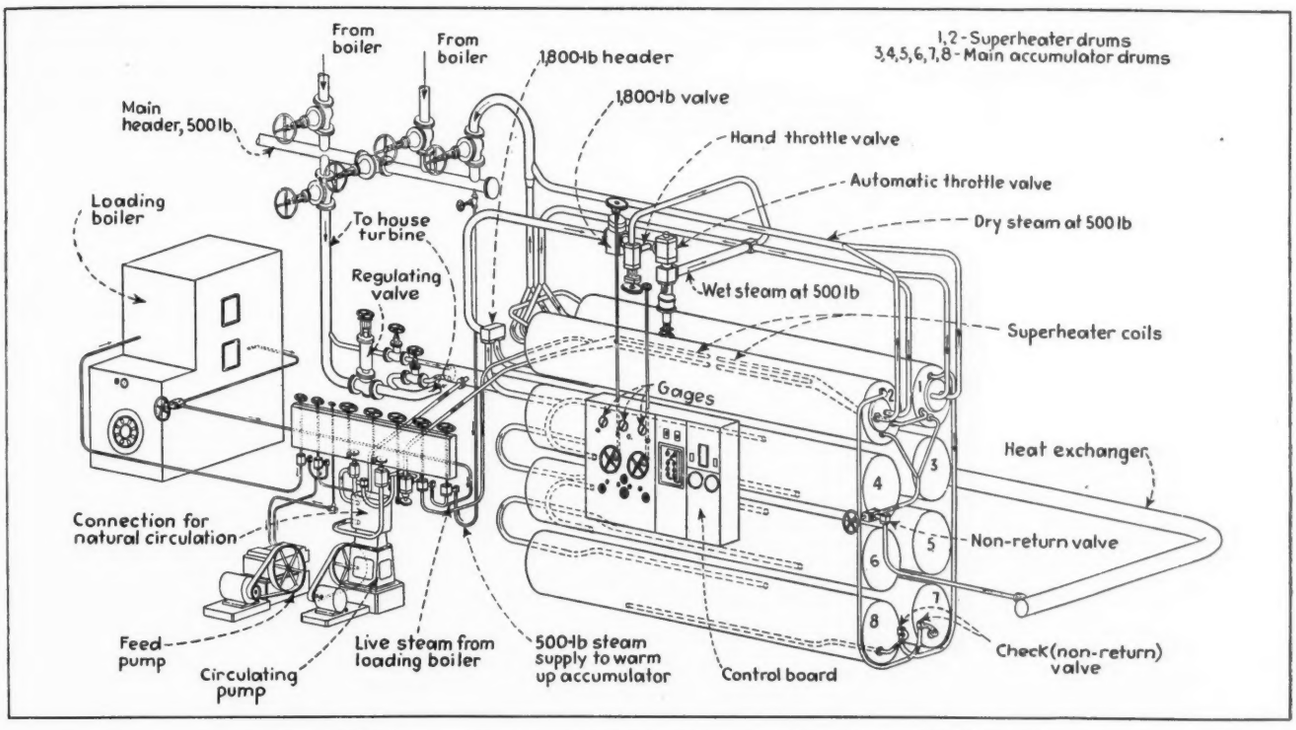


Fig. 2—Piping connection of single-tube charging boiler (left), feed pumps, circulating pumps, instrument panel and 8 steam-storage drums

to the throttle-valves, which reduces pressure to 500 lb. The high-pressure steam becomes wet during this throttling and is then dried in the superheater coils in drums 1-2.

When discharge starts, superheat ranges from 70 F to 120 F, according to the quantity of steam flowing through the superheater coils. Range is from 9 F to 18 F at the end of discharge.

Discharge piping and valves are so constructed that the entire capacity of the accumulator can be delivered in 8½ min., and in such a manner that a constant rate of 4400 lb per min is possible for the first four minutes. There are two throttle valves, the first oil controlled, operating automatically, the second hand operated.

Drums are lagged with aluminum-foil insulation (8 in thick), protected by a sheet-iron covering. Heat losses of the fully loaded accumlulator are 240,000 Btu per hour.

Accumulator discharge is controlled from the pressure of the main steam header in the boiler room. When header pressure falls to a predetermined value, oil pressure from the pressure regulator opens the throttle valve from accumulator to main header.

Two ways to charge the accumulator are provided: a special boiler and a heat exchanger. The special boiler is a "one-tube" generator (of Floridsdorf Witkowitz design). This single tube forms (in its various coils) economizer, furnace waterwalls, steaming coils and superheater. A piston pump forces feedwater through it at the constant rate of 6600 lb per hour. Outlet steam temperature is 935 F. Pressure ranges up to 1850 lb. Passing into the hot water of the superheater accumulator, this superheated steam generates the saturated steam which passes to drums 7-8 of the main accumulator.

Superheat Regulation

As already noted, feedwater passing through the charging boiler cannot be varied above or below 6600 lb per hour. Control of fuel oil regulates the superheat. This method of regulation prevents the water in the accumulator reaching too low a temperature, or the water in the drum becoming too hot before reaching the correct water level.

If feedwater supply fails, or if tube temperature rises too high, expansion of the heated tube shuts off oil supply to the burner. Full loading of the empty accumulator with the charging boiler requires about five hours, during which time pressure rises from 500 to 1700 lb.

Since the charging boiler serves to load the accumulator in a reasonably short time, basic duty of the heat exchanger is to replace heat losses during standby service. The accumulator can be loaded by the heat exchanger, but it requires 24 hours. In the heat exchanger, water of the accumulator is heated with live steam (500 lb, 750 F), which supplies the 5000-kw house turbine.

The heat exchanger consists of a 50-ft tube (15-in diameter), bent to a right angle to allow for expansion. Accumulator water flowing through it surrounds four smaller tubes carrying live steam to the house turbine. A valve regulates the fraction of the house-turbine steam flowing through the heat exchanger. All valves and gates were machined from solid steel. For standby service, heat losses of the accumulator are made up by the heat exchanger.

This accumulator went into service last October. To date there has been no trouble and all expectations have been fulfilled.

✦ ✦ ✦

Electricity in the U. S.

ACCORDING to the estimates of Mr. C W Kellogg, president of the Edison Electric Institute, the electricity output of the United States during 1937 totaled 119,000 million kwhr. The generating capacity at the end of the year is estimated at 35,042,000 kw, of which 9,617,000 kw was in water-power plants, 24,745,000 kw in steam-power stations, and the remainder in stations with internal-combustion engines. Excluding Federal work, about 455 million dollars were spent on power-station construction work during the year.

Speaking of Power

From Germany come reports of what seems to be a rather wild scheme of power generation, which I dare mention only because it is backed by Professor Foettinger, who achieved success with his system of hydraulic power transmission. His suggested prime mover combines some of the features of the coal-dust explosion engine, the Humphrey pump, the air compressor and the hydraulic turbine. . . . In brief, a water piston compresses the charge of air and coal dust. Expansion of the gases after explosion, forces water through a hydraulic turbine, generating power. Water leaving the turbine has enough remaining energy to compress the next explosive charge. . . . It is impossible to explain the design clearly without a picture, but this gives the general idea. No commercial units have been built, but experiments have been made and the prime mover is seriously proposed as a step toward solving Germany's difficult power and fuel problem . . . This startling announcement brings to mind all the early work done on gas turbines and reminds us that gas turbines have had little commercial success except those operating on exhaust or other partly cooled gases, as in the widely used exhaust-driven diesel superchargers. Just the same, it is rumored that the true gas turbine will soon blossom out.

A friend in the textile industry tells me power engineers

. . . universal language

in his field are at last convincing their plant managers that it pays to modernize obsolete power equipment. Their new-found secret is that the managers are either not interested in Btu's and efficiency, or else don't know what the words mean (probably both). So the engineers are now talking the universal language of dollars and getting a real hearing . . . The first man who said "money talks" spoke more truly than he knew. Even a mill manager can understand what it says.

April *Power* told of St. Louis' successful experience with air-conditioning installations using stored cold. "Ice Flywheel", we called it. By working 24 hours daily making ice, an undersized refrigerating machine can do an oversized cooling job for a few hours, because the melting ice will carry most of the load . . . Obviously this system is not suited to steady cooling loads, but it seems to have great commercial

. . . store cold as a bee

possibilities for churches, legitimate theaters, auditoriums and similar establishments requiring cooling only now and then . . . Given time, a little machine can store cold as a bee stores honey. In fact, the equipment involves a sort of honeycomb where the ice is frozen during off hours and melted during cooling periods.

Messrs de Malglaive and Hardy of the Institute of Marine Engineers (Great Britain) recently described "the trans-atlantic liner of the future" before that body. Showing the affect of anticipated airplane competition, specifications put today's sensational Normandie and Queen Mary in the shade. Here are samples: 1,350 feet over-all length, complete streamlining above water as well as below, air conditioning, no smoke stacks (gas led through tunnels to stern), 37 knots or better, 6 screws, 400,-

. . . Queen Mary in shade

000 shaft horsepower, turbine-electric drive (6 turbines), boilers with forced circulation and forced combustion, crossing time (Southhampton dock to New York dock) 3½ days, 2,150 tons fuel oil per day. Sounds fantastic, but so did the plans for Normandie and Queen Mary as announced a few years ago!

Years ago, when I was doing a lot of gas-analysis work, I used sticks of yellow phosphorus in the oxygen pipette of the Orsat, and found them much more rapid and reliable in oxygen absorption than the pyrogallic solution then commonly used. The phosphorus had its faults, though. For one thing it would melt down to a solid mass if the Orsat sat long in a very hot boiler room. This was embarrassing, because the stuff had to be melted out and replaced by new sticks. Yellow phosphorus is all right when submerged in cold water and handled with tweezers, but unskilled manipulation may easily cause serious burns and chronic poisoning. With these memories I was much surprised to learn that phosporus is now being shipped in tank cars. Shows what engineers can do when they set their minds to it.

It's human to be one-sided, which explains why the average engineer tends to be topheavy either on theory or practice. So here's a formula for the engineer who wants to get ahead faster: "If you're a practical man, brush up on theory. If you're long on theory, get more experience". This medicine is guaranteed to cure advanced cases of heartburn, particularly if it's sweetened with a little salesmanship and business horse sense.

For several weeks after publication we were swamped with letters about "So You Want to be an Engineer" (March *Power*). We had expected a favorable reaction from fathers, uncles and friends of young engineering hopefuls, but nothing like the deluge that almost buried our secretarial facilities. Twenty-seven letters on one day, almost 200 to date and still coming in. The S.O.S. for extra copies came from engineers, business executives, Y.M.C.A. secretaries, American Legion,

. . . "So You Want to be an Engineer"

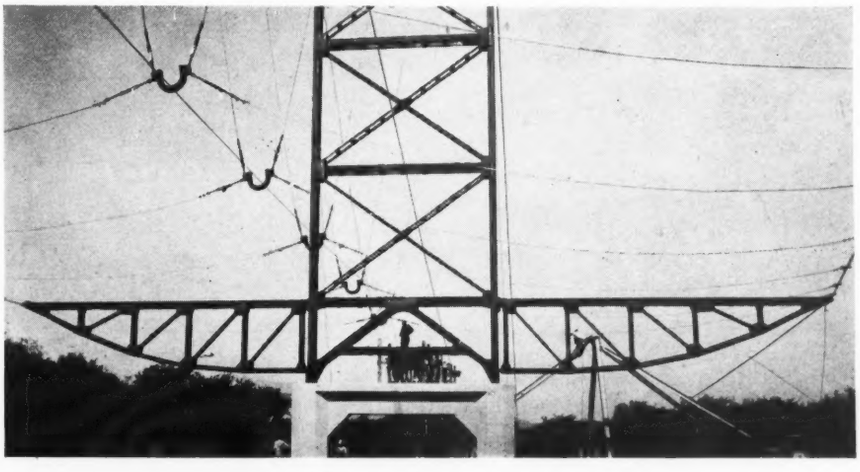
college professors and so on. One man asked permission to translate the whole article into Ukranian. . . . Among the many incidents was a telephone call from Missouri asking us to airmail, first class, a bunch of reprints to distribute to university students at an assembly on St. Patrick's day. . . . Perhaps it's time to reveal the history of this little article. I wrote it originally as a private letter of practical advice to my own nephew. Publication in *Power* was an afterthought.

PHIL SWAIN, Editor

Welded Skyway

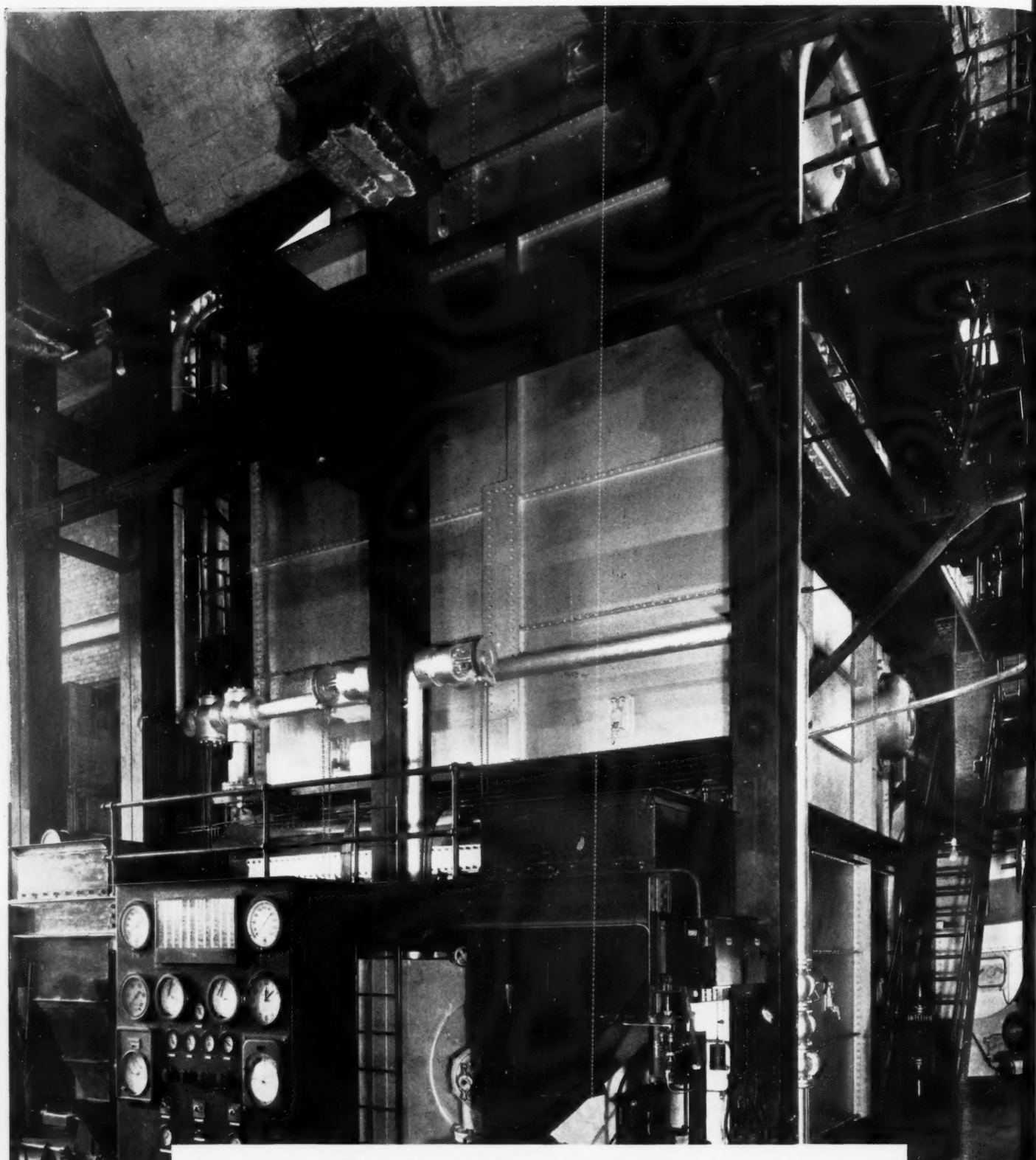
HERE'S HOW pipeline builders solved the problem of getting a welded natural-gas line across a river in Benson, Ariz. Although peaceful enough in these photographs, the river goes on a rampage every flood season, making ordinary pipe crossings impossible.

Two 85-ft towers, 1000 ft apart, carry the pipeline in suspension. Pipe sections were hoisted to platforms at each end of the bridge, Lindewelded in three sections, and fed out as follows: 250 ft from one end, then 500 ft from the opposite side, and finally 250 ft from the first end. Workers stood out on the bridge and steered the pipe sections as they were fed out. Note that pipe carriers (saddles) are securely guyed on both sides to prevent sway.



Above and lower left: Men steer a pipe section in the saddles as it is hauled out by cable. Left: One of the two towers, showing design of structural steel work and method of guying saddles (Photos courtesy The Linde Air Products Co)

The place to verify claims of Boiler Manufacturers



Firing Aisle of University of Minnesota
100,000 lbs./hr. Riley Steam Generating Unit.
Efficiency 85.2% at 100,000 lbs./hr.

is out in The Firing Aisle

It will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

It is only natural for salesmen to be extremely enthusiastic over their particular equipment. The consequent representations made to the purchaser often result in a maze of confusion. The surest way out of the confusion—the best way to assure the purchase of equipment best suited for your particular conditions—is to verify these claims by field inspections of equipment under actual operating conditions.

After all, the purchaser should be the one most interested in the selection of the best possible equipment for his conditions—he stands to lose most through the improper selection—he has to live with his selection for better or worse for years to come. He gains most if he chooses wisely.

Any manufacturer who is sure his equipment will stand up well under close scrutiny and thorough investigation naturally encourages such a procedure. Riley strongly encourages thorough field inspections, is more than glad to stand or fall upon the actual performance records of Riley equipment. This is only natural because Riley's phenomenal success and tremendous progress in the boiler industry in recent years can be attributed in large part to the unusually satisfactory performance of recent Riley installations and the enthusiastic appreciation of present users.

We sincerely feel that a purchaser in justice to his company and himself should visit a number of Riley installations before purchasing boiler or fuel burning equipment. On a visit to any of the many modern installations of Riley Steam Generating Units, you will find outstanding performance—extreme economies—trouble-free operation—minimum of maintenance—real satisfaction.

Such a visit will explain to you the reason for the rapidly growing preference for Riley equipment

and why the SWING continues to RILEY

A FEW RECENT SALES OF RILEY EQUIPMENT

Northern Paper Mills, Green Bay, Wisc.
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Winchester Repeating Arms, New Haven, Conn.
Humble Oil & Refining Co., Ingleside, Texas
Great Lakes Steel Corp., Detroit, Mich.
Otter Tail Power Co., Wahpeton, N. D.
U. S. Military Academy, West Point, N. Y.
Celanese Corp. of America, Cumberland, Md.
Lewiston Bleachery Co., Lewiston, Me.
N. Dak. Power & Light Co., Bismarck, N. Dak.
Hartford City Paper Co., Hartford City, Ind.
Hellwig Silk Dyeing Co., Philadelphia, Pa.
Libby Owens Ford Glass Co., Rossford, Ohio
Central Oil Power & Light Co., Findlay, Ohio
General Aniline Co., Rensselaer, N. Y.
American Brass Company, Kenosha, Wisc.
Godchaux Sugars, Reserve, La.
Moore Steam Turbine Co., Wellsville, N. Y.
Great Western Sugar Co., Billings, Mont.
W. Virginia Pulp & Paper Co., Luke, Md.
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A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

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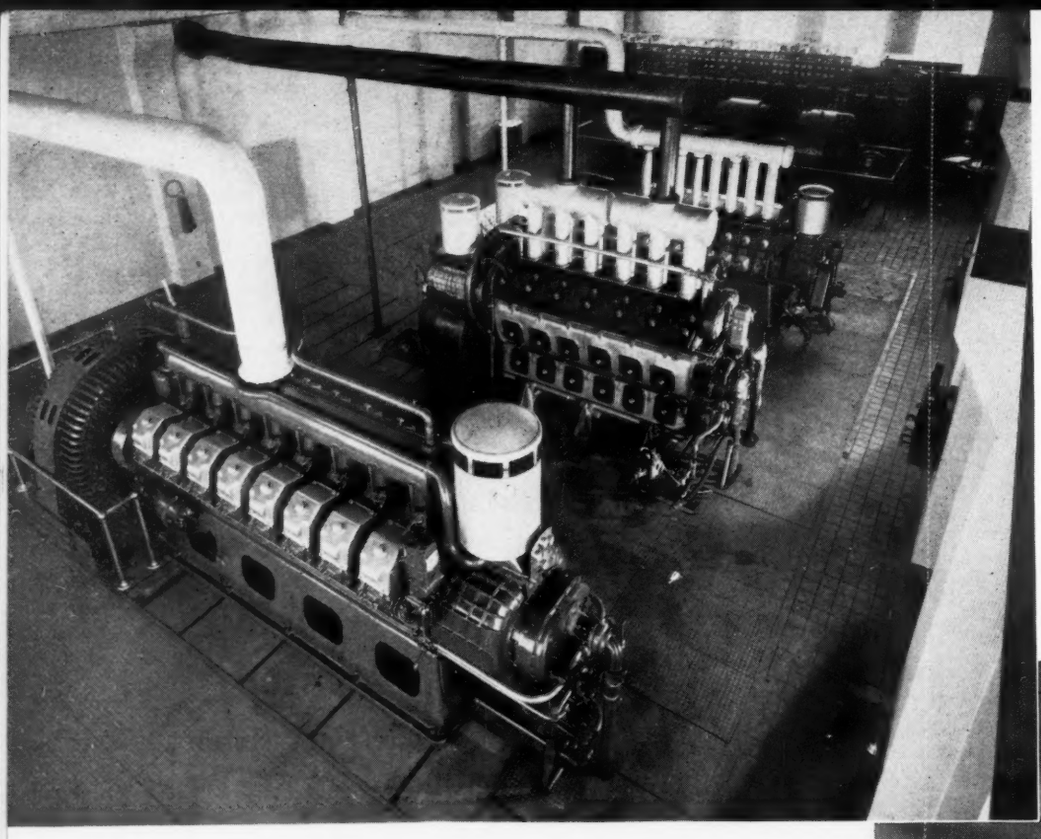


Fig. 1—Power room in new diesel test laboratory of General Motors at Detroit. These engines supply power to laboratory and adjacent manufacturing plant of Detroit Diesel Engine Division

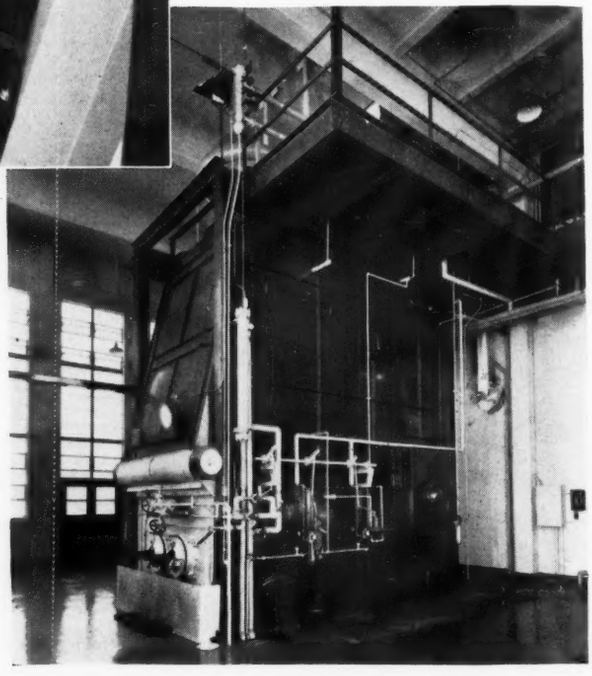


Fig. 2 — Oil-fired boiler (3150 sq ft) pools steam with electric boiler to heat factory and lab

LAB DRIVES FACTORY

PUTTING THE CART before the horse, General Motors' new Detroit diesel factory gets both power and heat from the laboratory building and much of them from laboratory-engine-test stands. Test-stand diesels, power-house diesels, versatile motor-generator set, electric boiler and oil fired boiler are partners in a unique heat-power pool that utilizes everything but the squeal and fades that out with soundproof building construction.

The laboratory, as completely new as the adjacent diesel factory (see March *Power*), tests General Motors diesels from the Cleveland and La-Grange (Ill.) factories as well as from Detroit.

Through the motor-generator set, power from engines on test in both laboratory and on factory test stands is used directly to drive the factory, or indirectly (through an electric boiler) to heat it. Output can be split as desired between the two. Then permanent power-house diesel sets make up electrical deficit and an oil-fired boiler any deficit of heating steam. To further perfect this setup, the electric boiler is elaborately equipped to load power-room engines as desired for test purposes.

Principal engine-room equipment (see table for details) consists of four diesel generating sets: 16-cyl, 1250-kva, ac; 12 cyl, 600 kw; 8 cyl, 400 kw, dc; 6 cyl, 100 kw, ac. There is also a 4-part mg set with elements of 1500 kw, dc, 550 volts; 1875 kva, ac, 4600 volts; 750 kw, dc, 275 volts; and exciter. Each element, except exciter, operates as either motor or generator, so the unit serves to pool all power sources on one side and all loads on the other. Thus it might be said that "MG Pools Power for GM".

The electric boiler, absorbing any available power, furnishes 125-lb

heating steam for factory. Balance of heating load is supplied by 3150-sq ft oil-fired boiler.

The 1860-kw boiler (all dc) resembles a miniature Scotch marine. Each of the 186 3¼-in. od tubes contains its individual 10-kw heating element. Electrically, the boiler is split into three parts, rated respectively 600 kw at 550 volts, 780 kw at 550 volts, 480 kw at 275 volts. Sections may be used simultaneously on independent test loads. The 780-kw section is for the 12-cyl engine, 600-kw section for the 8-cyl and 480-kw section for miscellaneous excess current from test stands or mg set. The 6- and 16-cyl engines can be loaded by first going through the motor-generator set and then into the boiler.

Each 10-kw heating element has its own contactor. Two 840-point motor-driven rheostats permit any desired subdivision of the 10-kw step. Thus, test load may be adjusted to any desired value accurately to the fraction of a kilowatt. It gives an extremely accurate dynamometer setup for the big engine. In winter, all power generated is utilized as power or heat. In summer, however, a cooling tower must dissipate excess heat produced by the electric boiler.

Eight dynamometer rooms for engine testing are adjacent to the permanent power plant and in the same building. Beneath the building is an elaborate system of service tunnels. The main tunnel connecting the power plant with the factory is a beautiful example of design and construction, all lines being highly accessible and well lighted. This connecting tunnel carries 275 volts dc either way between motor-generator system in the power plant and dynamometer test stands in factory.

The tunnel also carries high-pressure steam to the factory, water from cooling tower to engines, fuel oil to factory, condensate from factory to the laboratory, etc. All pipe is welded and supported on steel beams.

Alcoves under the various power-engine foundations house separate fuel-oil and lubricating-oil tanks for each engine, permitting precise individual measure of consumption. Each lubricating-oil tank is set permanently on a scale so that consumption can be measured by hourly readings.

Water to engines is automatically controlled for constant outlet temperature (about 160 F).

Power Plant Equipment

ENGINE ROOM

GM Diesel engine—16 cyl, 1200 hp, 720 rpm. Drives 1250-kva, 4600-volt, 3-phase, 60-cycle Westinghouse generator. Cranked by geared automotive-type starting motor.

GM Diesel engine—8-cyl, 600 hp, 750 rpm. Drives 400-kw, 550-volt, dc GE generator.

GM Diesel set—6 cyl, 100 kw, ac, 4600-volt to be installed and run continuously as endurance test.

Changer set (motor-generator combination)—4 Westinghouse motor-generator elements as follows on a single shaft at 514 rpm: *A*—1500-kw, dc, 550-volt; *B*—1875 kva, 3 phase, 60 cycle, 4600-volt; *C*—750 kw, dc, 275-volt; *D*—Exciter.

2 *Westinghouse motor-generator* sets with 30-kw, 440-volt ac motors: One driving 250-volt dc generator for dynamometer excitation; other 64-volt generator for battery charging and also for emergency engine starting (with batteries down).

Set of Maxim silencers on roof.

BOILER ROOM

Oil-Fired Boiler—Union Iron Works, 3150-sq ft, 125-lb WP (200 lb rated). Steam reduced to 3 to 5 lb for heating. Insulated and steel cased. Fired with Bunker C by 2 Todd mechanical-injection burners.

Boiler Auxiliaries—Cash regulator (balanced draft), Copes feedwater regulator, Eckenroth blowdown pairs, Sirocco induced-draft fan vee-belted to motor, Bailey steam flowmeter.

Electric Boiler—1860-kw, dc boiler built for Westinghouse by Ohio Machine and Boiler Co. Electrical parts by Westinghouse.

Boiler-Room Auxiliaries—Elliott deaerating heater, Laurence centrifugal feedwater pump, National Steam Pump Co duplex feedwater pump, Dean Bros "Durable" duplex steam fuel-oil pump, H L H gear fuel-oil pump, electrical preheater for "Bunker C" fuel, 3 sets Elliott duplex oil strainers, two 15,000-gal. boiler-oil tanks, two 15,000-gal. diesel tanks. Pneumercator tank gages.

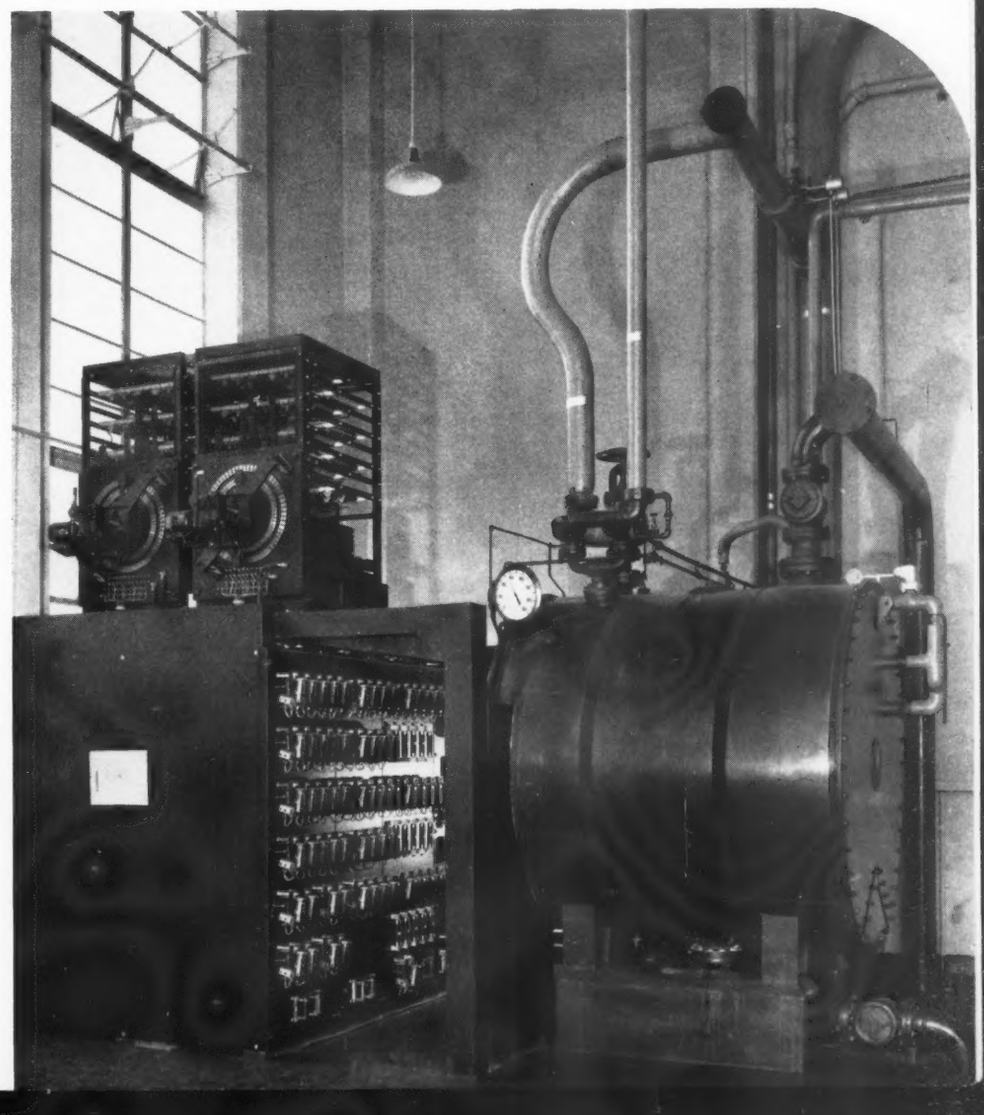
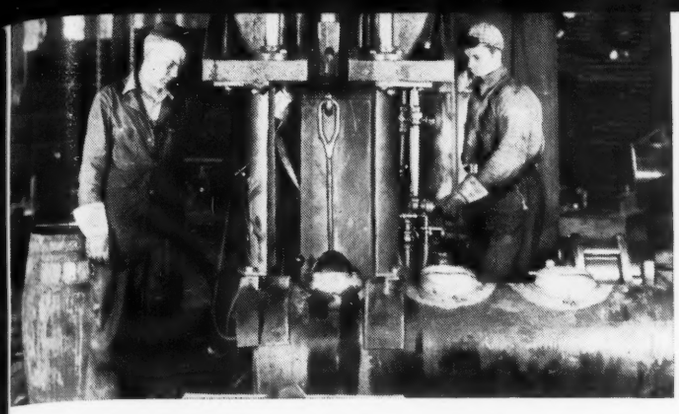
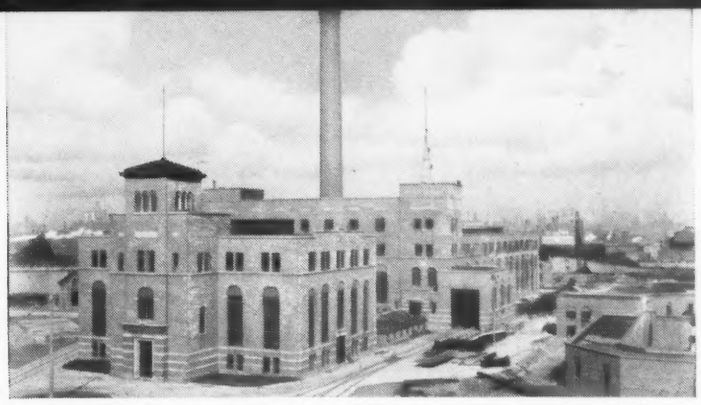


Fig. 3—Electric boiler has 186 10-kw heating elements, each with separate contactor for control of test loads. Motor-driven rheostats subdivide the 10-kw load steps

To Put This Label On

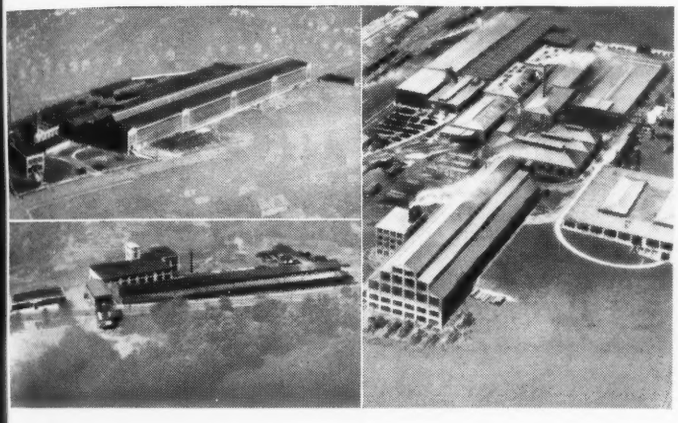


IT TAKES EQUIPMENT like these hydraulic extruding machines (exclusively Grinnell) which produce extruded outlets easily welded with strong, simple butt welds.

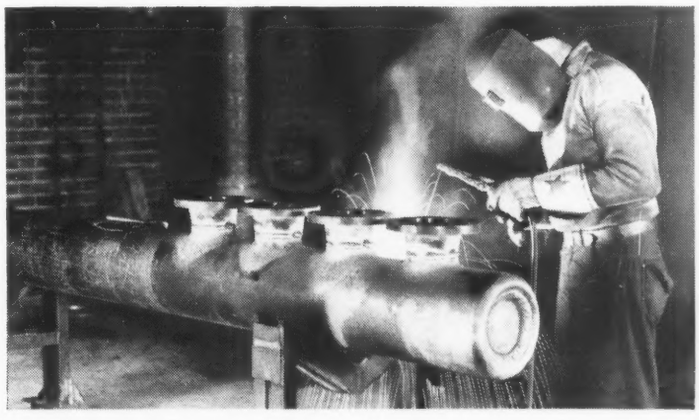


IT TAKES INTERPRETATION of the ideas and plans of engineers to provide correct installations for electric plants, tire manufacturers, mining operations, many others.

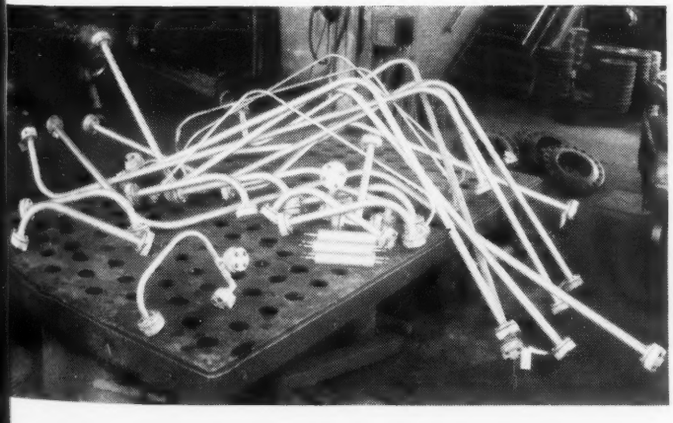
TAKES LOTS OF HANDS AND EQUIPMENT



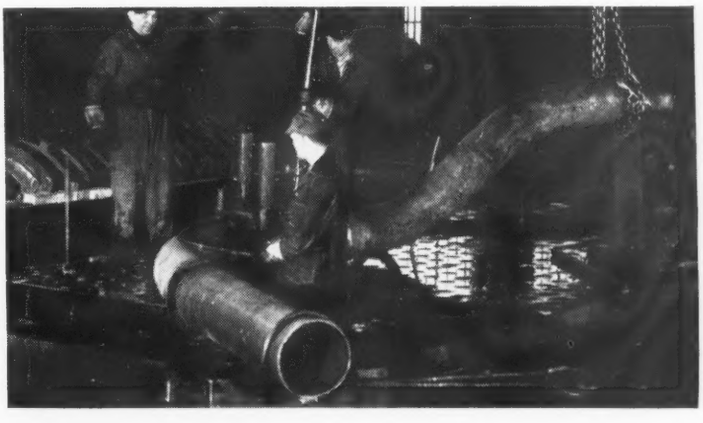
IT TAKES NATIONWIDE facilities . . . these three Grinnell plants at Warren, O., Atlanta, Ga., and Providence, R. I., are completely equipped, strategically located.



IT TAKES MEN qualified as pressure welders, so that Grinnell prefabricated units may be pre-tested to qualify for insurance. Thus prefabrication saves cost and labor.



IT TAKES KNOWLEDGE of the problems of many industries, and most modern answers to them. Stainless steel, rubberlined piping, new alloys are familiar to Grinnell.



IT TAKES COORDINATION . . . working together of all of these elements, to provide economical sub-assemblies, finished to close tolerances, and delivered on Grinnell's unfailing schedule. Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

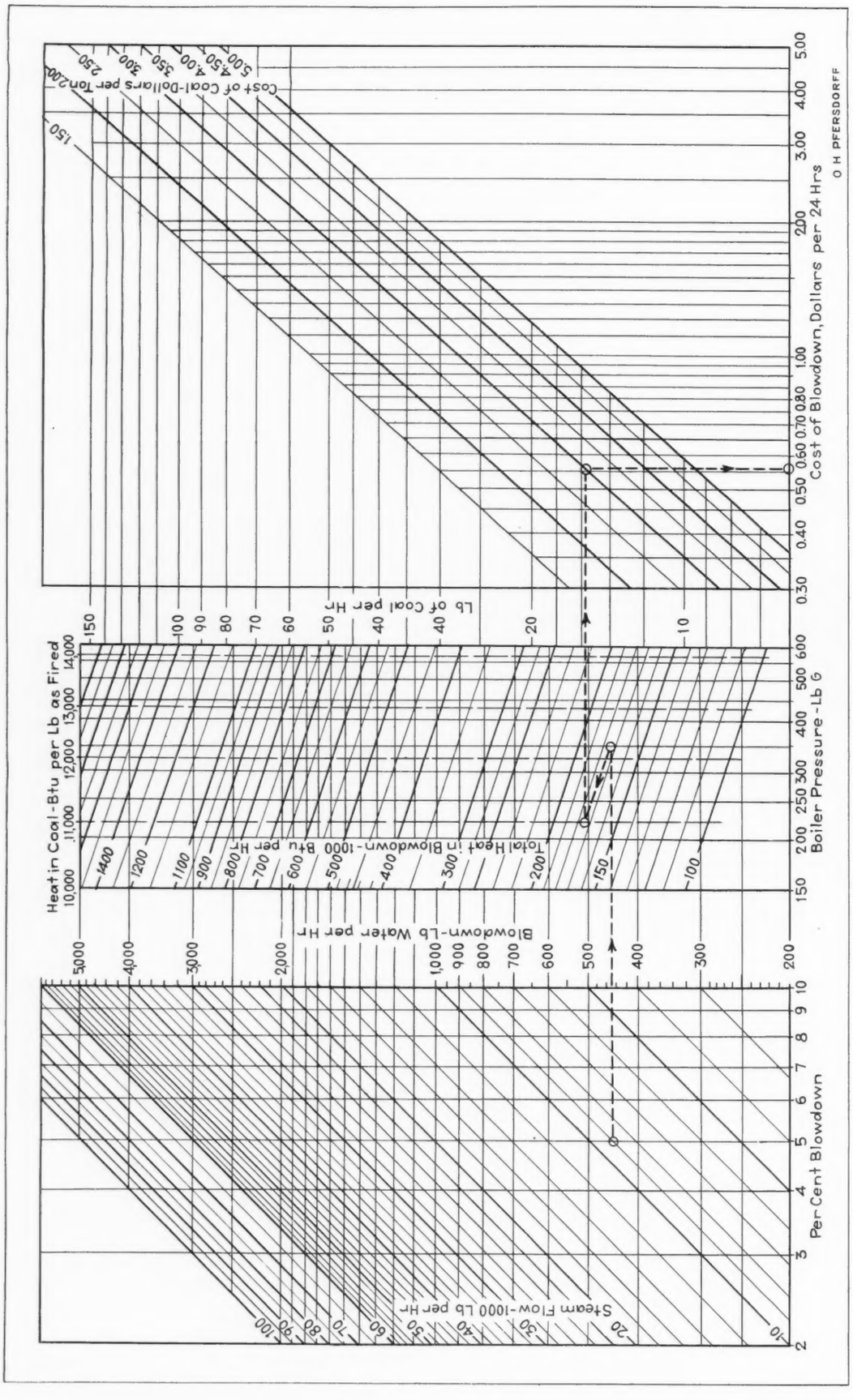
PREFABRICATION BY **GRINNELL**

WRITE for the picture-story "Grinnell Prefabrication."

...WHENEVER PIPING IS INVOLVED...

Number 69

Cost of Blowdown



For continuous blowdown with no heat recovery, this chart shows the cost per day of the heat lost. Makeup water is assumed to be available at 60 F. In using the chart, start with average steam flow and percent blowdown, which are 9000 lb per hr and 5% in the example. Go horizontally right to intersect boiler-drum pressure, 350 lb. Follow the slanted lines to the heating value of the coal used, in this case 11,000 btu per lb. Go right again to intersect the lines for price of coal, $3 per ton in the example. Cost of the heat loss per day is given on lower scale as 57 cents.

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Power Engineers Review Progress

Midwest Power Conference looks back 25 centuries, ahead to 1950, as engineers reveal advances in steam, diesel and hydroelectric power

NEARLY 500 power engineers met at Chicago's Midwest Power Conference, April 13-15, to discuss the problems of all the power industries—steam, diesel, and hydro. For the first time, the Conference was under academic sponsorship, which permitted maximum freedom of expression on the technical, economic and social aspects of power. Armour Institute of Technology was host to the conference, held at the LaSalle Hotel, and University of Wisconsin, Iowa State College, State University of Iowa, University of Illinois, University of Michigan, and Purdue University jointly supported the meeting. The program was notable for breadth of viewpoint and wealth of timely scientific information.

With present methods of generation, we are near the limit of improvements in thermal efficiency, according to Dr C F Hirshfeld, Chief of Research, Detroit Edison Co, who opened the first session with a paper on "Trends of Research in the Power Industry." It is now almost possible to predict the limits of efficiency gains from higher pressures and temperatures. Progress by these means requires the development of better alloys, more knowledge of corrosion and metals, purer feedwater, improved welding technique and non-destructive methods for testing welds.

Advances in electrical design depend on study of insulating materials, both solid and fluid. New methods of testing solid insulators, especially plastics, show good correlation with practice. Equally important work is being done on the properties of oils as insulators, where a radically new approach is yielding valuable results. Distribution savings must come from smaller capital outlays, according to

Fuel problems engage R A Sherman (left), Battelle Memorial Institute, and Joseph Harrington, Northern Illinois Coal Co.

Dr Hirshfeld, who cited the importance of a newly-discovered method of "seeing" the inside of a cable, before and after use. This is accomplished by petrifying the cable interior, thus making it possible to cut wafer-thick sections for examination. This method may be applied to the study of slag, metallic deterioration, and packings.

With the limit of improvement by present methods in sight, Dr Hirshfeld pointed to the possible generation of power by gas cells, converting chemical energy directly into electrical energy. While still a laboratory process, it may eventually be practical on a larger scale, he said.

Predicting that the machine will eventually abolish practically all monotonous and distasteful work, Philip W Swain, Editor of *Power,* spoke on the "Social Significance of Power Progress." "Every evil of the machine age can be cured," said Mr. Swain. "On the other hand, any attempt to restore primitive methods of agriculture, transportation or manufacturing (with present populations) would create utter chaos. Today, thousands of machines move their own levers, read dials, judge color, make records, carry out elaborate instructions. Modern controls have eyes, ears and memories. Many can add, subtract, multiply and divide. Some seem to have judgment. The ultimate end of all this, if man permits, is to leave nothing for man to do but the interesting jobs. Already we face a tremendous increase in the relative demand for skilled workmen. Fewer and fewer workers are needed for the dull jobs, more and more for skilled and interesting work.

"The capabilities of power and machines include many of the things the world is seeking. Yet, if experience is any guide, he will not get most of them quickly. So far he has profited greatly by his use of power and machines, but not at all in proportion to the horsepower hours used. The reason, of course, is mutual cancellation of benefits, largely as a direct result of human stupidity and folly.

"As one of our great philosophers has pointed out," Mr Swain concluded, "the simple fact is that man has never given the machine age a real trial. To date there has only been a rehearsal. This reveals magnificent instruments, many talented musicians and actors. There is no score, no libretto, and no director. Still it may be a great show some day."

Fuel Problems

Fuels and fuel problems occupied the attention of the power engineers at the first technical session. Listing many fuel problems still to be solved, Ralph A Sherman, Battelle Memorial Institute, showed how competition between fuels and methods of burning stimulates investigations, leading to new equipment and methods. After citing the advantages and general characteristics of gas and fluid fuels, Mr Sherman turned to a more detailed discussion of coal, our major fuel. Coal must be made worth more if it is to be sold at the higher prices which will permit the industry to continue operations without losses. This may be done by eliminating some of the inherent disadvantages of coal, which include high ash content and variability of characteristics. Carbonization is widely used, but sale of coke is limited by the market for byproducts which make the process economically practical. Hydrogenation or complete gasification may be the solutions, but are not yet economical. Immediate need is for better burning equipment to handle many kinds of coal without trouble. Pulverized-coal burning, the spreader stoker,

and many small stoker types, approach this ideal. Continued research and distribution of new information on coal burning will help enormously.

Colloidal fuel, oil with finely ground coal suspended in it, was first suggested in 1879, according to F W Godwin, of the Research Foundation, Armour Institute of Technology, the second speaker at the fuels session. Early efforts were aimed at a true suspension, but cost of grinding particles fine enough made this method prohibitive. Present investigations center on the use of a stabilizing agent to hold coal, at about 200-mesh fineness, in suspension for the required time. Laboratory tests and practical use show that a colloidal fuel can be handled, pumped and burned like oil, using oil equipment. Its use would save oil, open new markets for coal, and give the user a higher heat content per cubic foot, important where storage space is a factor.

Colloidal fuel burns with smokeless flame, and has an ash content between that of coal and oil, which can be lowered by removing ash in grinding. It is not, however, quite ready for general use, although trials have been made in locomotives, ships, and stationary plants. Biggest problem is stability, which should be maintained for a year at least. Methods of testing stability are needed and improved grinding is also essential.

Sewage Gas

"Gas from Sewage Disposal Plants" was the newly utilized fuel discussed by W B Walraven, Sanitary District Engineer, Springfield, Ill. As handled at Springfield, sewage, about 97% liquid, runs into deep tanks, and heated to about 85-95 F, where decomposition occurs. Some of the solid gasifies, some liquifies, the gas being about 65% methane, 32% CO_2, 2-3% nitrogen, and containing traces of CO, oxygen and hydrogen sulphide. About 8 cu ft of gas is generated per capita, per day, in a well-run disposal plant. Heating value is about 650 Btu per cu ft.

Springfield was the first plant to use this fuel successfully in a gas engine, a practice that has spread rapidly in recent years. These engines operate well, with only minor difficulty occasionally from hydrogen sulphide. The sulphide can be scrubbed out, but such treatment is rarely necessary. Sewage gas is slightly harder to fire and requires setting the firing point well ahead of that for methane.

Engines should be rated carefully for sewage-gas burning, since about 5-6% capacity is lost on this fuel. For modern slow- or medium-speed engines, about 70 brake mep is the limit, based on tests made at Springfield. No serious troubles have been encountered except, strange to say, with magnetos. The best compression ratio seems to be 6-1, but higher ratios might be used and it may be possible to burn this gas on the diesel cycle.

Use of sewage gas for power generation has proved worthwhile at Springfield, Mr. Walraven concluded, citing a saving of $26,000 in four years on an investment of $42,000 and in comparison with electric current at 9 mills per kwhr.

Speaking in a simultaneous session on electric power equipment, W E Blowney, of General Electric, reviewed trends in turbine design. In 3600-rpm machines, he said, effective blade length in low-pressure stages, reaches 20 in. and tip speed 821 miles per hr. Improved methods of frequency conversion may eventually permit generator speeds above 3600 rpm. At present, the largest 3600-rpm machine on order is 40,000 kw. While 950 F is present limit of safe steam temperature, further slight rise may eventually be practical, he said. Reheating, in vogue around 1929, became unnecessary with higher throttle temperatures, but the present trend to raise pressures above 1400 lb may bring reheating back. Speaking of "tops," Mr Blowney suggested that in some cases it pays to replace the low-pressure turbine when a topping unit is installed.

At the same session, J H Cox, of Westinghouse, surveyed trends in electrical conversion equipment and O K Marti, of Allis-Chamlmers, covered developments in electronic switching equipment. With the ignitron, Mr Cox said, rectification is now attractive down to 250 volts. A 750-kw, 250-volt unit maintains an efficiency above 92% over most of its load range.

Power Plants

Tracing the development of power practice from the early days, Arthur L Rice, of *Power Plant Engineering*, acting as chairman, opened the session on "Developments in Stationary Power Plants." After outlining the growth of use of high pressures and temperatures, G A Hawkins, Research Associate, Purdue University, said that 2500 lb was probably the upper limit for natural circulation. Balanced flow in the circuits of a series boiler is essential, especially at the high pressures for which these units are suited. Purdue tests on unbalanced flow revealed that circuits of continuous tubing are unstable and that stability can be attained by the use of resistors at the outlets or equalizers properly located.

Difficulty in producing clean steam is a serious limitation on the Purdue boiler, Mr Hawkins said, and suggested solving it by inserting a separating drum at the end of the evaporating zone to receive the steam and water mixture and discharge clean, dry steam. A forced-circulation steam generator of this type is the recently announced "Steamotive."

Modern operating temperatures bring superheater tubes within the range where oxidation of steel by steam becomes a serious problem, said Mr Hawkins, describing an investigation under way at Purdue to determine the rate of oxidation of various commercial alloy steels in contact with high-temperature steam. This data and new data being developed on the viscosity of water and steam at high temperatures and pressures should prove extremely helpful in design, he indicated.

Speaking principally of boiler units and firing equipment recently installed in industrial power plants, F H Rosencrants, Combustion Engineering Co, presented figures showing a marked

Dean Melvin L Enger (left), University of Illinois, and W L Abbott (right), Commonwealth Edison Co, look on while Dr Hirshfeld (center, right) amplifies a point for S N Tideman, Sanitary District of Chicago

trend toward larger units and higher pressures. Most installations are now in the 3600- 5000-sq ft class, and in the 400- 500-lb pressure range. Biggest factor in determining industrial plant pressures and temperatures is the generation of byproduct power; the ideal pressure being one that will provide all power needed by expansion to the pressure required for process work; the ideal temperature will produce saturated steam in the process lines. Pulverized coal and stoker firing are about evenly represented according to Mr Rosencrants' figures, with standardized boiler units becoming more common and watercooled walls practically accepted practice.

Methods of firing are still governed by local conditions in most cases, Mr Rosencrants stated, with many installations designed for use of alternative fuels. With single-boiler, single-pulverizer installations, a hazard exists at light loads that might make stokers a wiser selection. Placing a small storage bin and feeder between the mill and the burner would protect against interruptions in coal feeding.

Higher pressures and high percentages of makeup require greater attention to feedwater treatment in industrial plants, with continuous blowdown advisable in many cases. Active development of steam washers in the past five years has helped to eliminate carryover; the added expense of the washer is justified where high-pressure boilers supply turbines with steam at 500 lb or above.

Flowmeters

Speaking on "The Measurement of the Flow of Fluids in Pipes," Dr M J Zucrow, consulting engineer, Chicago, described the parts of a typical flowmeter, the major types of meters, and then presented general flow equations for meters. Stating that absolute viscosity of the fluid measured was the most important factor affecting the discharge coefficient of a meter, Dr Zucrow analyzed this factor and its effect on the coefficient. After presenting detailed discharge coefficients, he discussed flow characteristics at very low Reynold's numbers, a field in which little data are available. At the same session, Royce E Johnson, Director, Electrical Standards Laboratory, University of Wisconsin, discussed "Portable Standard Watt-Hour Meters."

Using life experience curves as a basis, E B Kurtz, Head, Department of Electrical Engineering, State University of Iowa, presented the theoretical considerations involved in the valuation of power plants. Practical issues involved were then discussed by C F Harding, Head, School of Electrical Engineering, Purdue University,

Tom Wilson (left), Mgr Chicago office, Engineering Societies Employment Service, settles a fine point with Arthur N Gregg, secretary, Educational Committee, NAPE

who reviewed many recent legal decisions and developments in this complex field, giving special attention to the newly revived prudent investment theory of valuation.

Economic aspects of high-pressure steam plants were analyzed by W S Monroe, of Sargent & Lundy, in a paper presented at a luncheon on the second day of the conference. Double-reheat, 2400-lb stations were considered a definite possibility, reducing turbine-generator heat rate by about 500 Btu as compared with 1200 lb, single-reheat plants. Nevertheless, he pointed out, the economic advantage of the 2400-lb plant is questionable. At 2400 lb, water weighs only 28.6 lb per cu ft more than steam, making natural boiler-water circulation extremely difficult and therefore favoring forced circulation or once-through boilers. Mr Monroe could see little advantage in such boilers for 1200 lb or less.

Stressing the advantages of topping as a means of increasing capacity and efficiency at very low cost and without adding to water and equipment requirements of the condensing system, he suggested that Chicago's Crawford Ave. Station might someday be topped at 2400 lb, because of condensing-water limitations. He predicted further changes in boiler design and ultimate commercial steam temperatures above 1000 F. Fixed charges, now 50 to 60% of generating cost, are twice as important as fuel costs, about 30%, Mr Monroe concluded.

At the same luncheon, Frank F Fowle, consulting engineer, analyzed the nation's public debt and taxes in comparison with its bill for the three major utility services, telephone, power and railroads. Pointing out that taxes (national, state and local) amounted to 59% more than the combined utility bill of the nation, he declared that the people would benefit more from reduced spending and a lower public debt, than from any possible reduction in the utility bill resulting from subsidized Government competition, or government ownership.

Materials

Materials for power plants were considered at another session, with Dr A E White, Director of Engineering Research, University of Michigan, and J P Magos, Crane Co, as the principal speakers. Discussing the metallurgy of power plants, Dr White said that steel with 20% or more chromium is now preferred for soot-blower heads, and that the trend in superheater-tube materials is toward the 18-8 alloys. Steel has become almost universal for high-pressure valves, flanges, and fittings, with special materials or surfacings for valve stems and seating surfaces. The trend in valve bodies is from cast steel to carbon-moly. A favored composition for condenser tubes is 22% zinc, 2% aluminum and 76% copper.

With many slides, Mr Magos presented the results of experiments in erosion by steam. Disks of various materials were subjected to high-velocity steam for 100 hrs in a special machine, and then photographed. Strangely, mere hardness seemed to have little to do with erosion resistance. For example, such an ultra-hard material as carboloy erodes considerably, while the much softer stainless steels are practically unaffected. Mr Magos concluded that resistance to erosion is closely associated with corrosion resistance. Thus a valve with both seat and disk of stainless steel might be thought ideal. However, the same metals in contact would gall, so for ordinary use he suggested pairing stainless steel with a copper-nickel-tin alloy. For high-pressure, high-temperature service, the stainless steel would be paired with the more costly Stellite.

In a prepared discussion, Dr T C Poulter, Executive Director, Research Foundation, Armour Institute of Technology, presented sensational evidence of the porosity of metals and its increase by hydrogen. He told of forcing a cubic inch of oil through "solid metal."

Operating problems in high-pressure steam plants, diesel plants, and hydro developments were thrashed out in another session. "Chemical problems are acknowledged to be the most generally important ones in high-pressure (1200 lb) steam plants at present," said M K Drewry, Asst Chief Engineer of Power Plants, Milwaukee Elec-

tric Railway & Light Co, in discussing the operation of high-pressure steam plants. Citing the tremendous increase in corrosion rates with increase in temperature, he pointed out that scale and embrittlement have not been problems in most high-pressure boilers now operating, but that corrosion has been the major difficulty. Iron-phosphate films have proved effective in stopping high-pressure boiler corrosion, he said, and emphasized the vital need for eternal vigilance to secure as near a zero oxygen value as possible.

Temperature regulation, especially where superheater duty equals or exceeds boiler duty, is especially important. Transference of 5% of boiler duty to the superheater (by a change in ash accumulations, for example) would cause a 100-F increase of reheater outlet temperature. Further difficulties accentuated by high pressures and temperatures, result from thermal stresses set up in equipment. Thermal expansion makes it difficult to build turbines with the close clearances needed for high efficiency at high pressures. Better feedwater regulation is demanded by smaller drum storage of high pressure units.

Diesel Operation

Fourteen years experience with diesel plants operating as peak-load, standby and base-load units in a utility system, was summed up by John M Drabelle, Mechanical and Electrical Engineer, Iowa Electric Light and Power Co. Their experience indicates the diesel has a useful field, but is not a cure-all; it seems best suited for use where water and coal are scarce, and loads are small. Mr Drabelle pointed out that not enough attention is paid to auxiliaries, heat exchangers are apt to be too small, water treatment and algae-growth retardation are important, cooling ponds and towers are often too small, oil filters are vital and should be supplemented with extra filters in many cases, pyrometers are necessary and helpful, nozzle testing is valuable as a check on operating conditions, and air filters prove their worth in the West where dust storms occasionally arise. Discussing fuel oil, Mr Drabelle said that his company makes lab tests on a sample from every tank car, and they have found that wide variation exists, rejection being necessary in some cases. During past years, oil prices have gone up, taxes have increased in many cases, and as a general thing, today's oil is poorer in quality.

Good operation depends on well-trained and well-paid operators, comprehensive plant records, and carefully worked-out maintenance and inspection routines. Engine difficulties seem to center in the cylinder heads, with water circulation still at fault. A definite cycle of maintenance costs can be observed, with low cost during first 2-4 years of engine life and heavy costs from the fourth to the sixth year.

Dean A A Potter (right), Purdue University, converses with A T Hunt (center), while Verne Alden, Stone & Webster, listens

Hydro operation problems relate closely to maintaining public understanding, particularly in such matters as rates, continuity of service, alleged flowage damages, and maintenance of game fish in dammed streams, according to Grover C Neff, President, Wiscousin Power & Light Co. Maintenance problems include those arising from lowering of tailwater as a result of hydro operation when the plant is on a rock foundation and the river bed is rock, tainter-gate sealing, disintegration of concrete, corrosion of turbine parts, algae growth in waterjackets of transformers, ice jams, etc.

A special session on hydro power first heard the story of "Dams—Ancient and Modern," by E W Lane, Associate Director in Charge of Hydraulics Laboratory, Iowa Institute of Hydraulic Research, and then a paper on "Problems in the Design of Masonry Dams," by A V Karpov, Chairman of the Committee on Masonry Dams, American Society of Civil Engineers. Discussing first the relation of the topography of the dam site to the shape of the dam, Mr Karpov next presented an analysis of the stresses in masonry dams, and the elastic properties of the foundation rock, concluding with prevention of erosion at the toe of overflow sections and a discussion of the conformity between asumptions and conditious.

The last day of the Conference was featured by a meeting at Armour Institute in which H O Croft, Head, Dept of Mechanical Engineering, State University of Iowa, presented a paper on "Heat Energy Costs of Btu Auditing" and A P Kratz, Research Professor of Mechanical Engineering, University of Illinois, spoke on "Power Requirements for Residential Air Conditioning."

✦ ✦ ✦

British Diesel Data

DATA from 66 diesel plants in Great Britain and the Empire are included in the 1936-1937 report of the Diesel Engine Users Assn, recently released. Average fuel consumption for all stations was 0.647 lb per kwhr and 31 stations reported being below the arbitrary standard of 2380 rated bhp hrs per gal. of lubricating oil, the average figure being 2275. Particular interest attaches to the long-time trend in these figures, which reflects improvements in design and operation, and changes in the average age and size of engines.

Fuel consumption started at 0.734 lb per kwhr in 1922-23, first year of the report, varied in the neighborhood of this figure for several years and finally fell below 0.700 lb in 1930-31. Lowest reported consumption was in 1934-35, when 0.637 lb per kwhr was the average. Lubricating oil followed a somewhat similar trend, starting with an average of 1330 rated bhp hrs per gal. Oil consumption improved slightly for several years then fell off to about the same figure as at the beginning. Since 1929-30, a steady improvement has been registered. It should be remembered that these figures are averages from a limited number of plants, of varying size and age and operating under widely different conditions.

Discussion of the report by members of the association stressed efforts to lengthen the period elapsing between overhauls. The Engineering Div of British Broadcasting Corp reported that they had been able to increase the normal period between overhauls from 3000 hrs to 8000 hrs, representing a saving in labor.

Current Comment

The Steam Engine in Power Generation

To promote reader discussion of the place of the steam engine in power generation, we present two views, the first by a manufacturer of engines, the second by the editor of POWER. *It is unlikely that these tell the whole story, so interested readers are invited to submit brief discussions for later publication*

The Case for the Engine

By F J VONACHEN
Troy Engine & Machine Co

FORTY-FOUR power cost surveys were recently completed in 43 leading concerns and institutions in 29 different fields, using steam engines to drive 10 different types of machines. The data were obtained from these concerns and the surveys checked by their engineers. The average power cost in the 43 plants was ½ cent per kilowatt hour. Many were ¼ and ⅛ cent. One was as low as 1/10 cent. In 24 cases where comparative power costs were available, the average investment was $1100, the annual savings $1600, and the average annual return on the investment 114%. Power costs were reduced 71%.

A typical example is the following survey of the Penn Harris Hotel, Harrisburg, Pa., one of the United chain, an installation engineered by A N Brent of the hotel and George J Humbert, United Hotels Co, Niagara Falls, N. Y. The steam engine drives a compressor for general refrigeration. During the heating months, exhaust steam is turned into the heating mains. In warm months it is used in a jet condenser for air conditioning.

All costs are included. Note the high return on the investment, 198%, and that the large savings pay for the entire investment in 6 months.

Data:

Engine—10 x 6 in.
Maximum bhp—25 at 375 rpm
Average bhp—20 at 375 rpm
Hours operation per year—7500
Steam pressure—85 lb gage
Superheat—None
Back pressure—12 lb gage
Feedwater temperature—200 F
Cost of steam—37c per 1000 lb
Cost of engine installed—$978.00
Cost of motor installed—none, motor on hand
Extra labor to operate engine—none
Purchased current rate, including demand charges—1.76c per kwhr
Part of engine exhaust used for heating and processing—100%
Has operation of engine been satisfactory?—Yes

Annual Engine Cost:

Depreciation, 5% of $978	$48.90
Average interest at 6%, $978 x 0.0315	30.80
Maintenance—2% of $978	19.56
Steam consumption, for average load of 20 bhp, is 1112 lb of steam per hour	
Calculated heat left in exhaust—92.7%	
Calculated heat chargeable to engine—7.3%	
Steam cost chargeable to engine	226.00
Lubrication cost (cylinder operates without oil lubrication)	11.90
Extra labor	None
Total	$337.16

Annual Motor Cost:

(Since this motor is on hand, no depreciation or interest is charged)

Maintenance	$7.23
Current cost—128,800 kwhr at 1.76c	2266.88
Lubrication cost	0.76
Extra labor	None
Total	$2274.87

Annual Saving:

$2274.87 — $337.16 ..... $1937.71
This saving gives a yearly return of 198% on the entire engine investment and will pay for the entire cost of the engine in 6 months.

Power Cost at Compressor Shaft is:

Engine ..... 0.262c per kw hr
Motor ..... 1.76c per kw hr
Engine Power is 85% cheaper

In connection with the above results, purchased-power cost is cited without prejudice. Purchased power has its place in industry, as has the steam engine. When there is need for steam for heating or processing or both, the engine fits definitely into the picture, as it produces and maintains low-cost power for various machines such as stokers, forced- and induced-draft fans, generators, refrigeration and air compressors, ventilating fans, blowers, exhausters, kilns, cookers, dryers, conveyors, pumps, line-shafts and similar equipment.

The table on the next page is a resume of 26 of the 44 surveys. The remaining 18, showing similar results, cannot be shown here for lack of space.

It should be mentioned that steam at 80 to 150 lb and higher pressures can be generated by a boiler at only slightly greater cost than at low pressures. This steam can be put through the steam-engine cylinder, which serves as a reducing valve, to generate power. Depending on actual steam conditions, approximately 90% of the heat in the initial steam will be present in the exhaust for heating and processing to take the place of live steam previously used. Thus the steam does double duty: first, in passing through the engine it generates power; second, it retains approximately 90% of the heat in the exhaust for heating purposes.

Cost of generating this byproduct power consists of operating and fixed costs. Operating costs are about 10% of the steam cost (the other 90% of the steam cost being rightfully charged to heating cost), and lubrication cost (Fixed costs based on 20-year life are: interest on investment, say 6%; annual depreciation, 5%; annual maintenance, 2% (which is ample as maintenance is very small). As a general rule, no extra operating labor is necessary with the modern steam engine. In spite of numerous items in the cost, the total is so low that steam engines usually pay for themselves in 6 to 12 months by the saving in power cost.

Some plants require steam free from cylinder oil. Many steam engines are being operated satisfactorily today without oil cylinder lubrication. The Penn Harris installation is an example. With the cylinder properly constructed and glazed by the use of beeswax and graphite (a method that has been used for years in the highly critical marine field, as well as the stationary field), it may be operated without any lubrication, except possibly the introduction of a slight amount of beeswax and graphite at infrequent intervals. A solution of colloidal graphite in distilled water, introduced into the cylinder by a special mechanical cylinder lubricator, can also be used with excellent success.

Heat Balance

Since the steam rate of the engine remains low throughout the entire speed range and even at high backpressure, the amount of exhaust best meets the requirements of most plants and a good plant heat balance results. There is no limit to the amount of back pressure if there is sufficient initial pressure to produce the required power within the limits of practical cylinder bores. As this low water rate is closely maintained throughout the long life of the steam engine, the original plant heat balance is also maintained. This is quite important if greatest saving is to be obtained.

The modern steam engine is suitable for a wide range of steam conditions: 20- to 400-lb pressure, very wet steam to 750-F total temperature, vacuum to 75-lb and higher backpressure. It is not damaged by the usual chemical impurities in steam.

Regulation

Flexibility, accurate control, economy and reliability are all essential factors which are met by the modern steam engine. In variable-speed service, it has a wide, smooth, easily adjusted, speed range with infinitely small steps and is well adapted to automatic control. Whether the control is manual or automatic, definite speed is maintained for each point of control. In other words, there is good regulation and, of prime importance, no hunting. Constant-speed engines, for example, those driving generators, use the automatic governor which gives regulation within 2% from no load to full load. Steam engines are also quickly started, as very little warming-up is required. They can be placed in service very quickly.

As to reliability, the modern heavy-duty steam engine is of rugged construction, has been continuously improved and

is fully enclosed, self-oiling and oil-tight so it is quite common to have months of 24-hour continuous service at full load without a shutdown.

Its speed is conservative and conducive to long life. Compressors, exhausters, pumps, fans, generators, may be direct connected. Only a small speed reduction is necessary to drive stokers, cookers and conveyors. Higher speed fans, blowers and dryers may be driven by flat or V-belts, or chains. Its high starting and running torque and large overload capacity are desirable features for most installations.

I Agree and Disagree

By P W SWAIN
Editor of POWER

My slant on this matter of steam-engine costs is, in some respects, the same as that expressed by Mr. Vonachen. In other respects it is different, the differences being mainly matters of selection, emphasis and interpretation. Here are some of my thoughts on steam-engine power, with particular reference to Mr. Vonachen's figures and arguments.

Without pretending to check the tabulated survey as such, we can at least say that extremely low power costs, such as those listed, seem possible under suitable conditions. *Power* has repeatedly stated that where all of the exhaust is absorbed in heating and process, the cost of steam chargeable to power is almost negligible.

Mr. Vonachen estimates steam chargeable to the engine by first computing the quality of the exhaust steam. No basic objection can be raised to this method, which is commonly used and technically sound. Personally I prefer the simpler, and equally accurate, procedure of charging 3 lb of steam per hphr, or 5 lb per kwhr for power generated purely as a by-product. Unlike the quality of exhaust steam, these constants are practically unaffected by the steam rate of the engine. The engine must, of course, be charged with the full amount of any throttle steam later exhausted to waste.

It will be noted that most of the plants listed utilize 100% of the exhaust, the situation most favorable to low engine-power cost. One plant, however, lists a cost of 0.522 cents per kwhr in spite of the fact that none of the exhaust is utilized. The steam rate is not specified, but this result would not be possible except with steam of extremely low cost.

In the plants where no motor has been installed, and therefore no actual kwhr records are available, it would appear that the computed equivalent kwhr for the engine may be no more than rough estimates obtained by multiplying the estimated hours of operation per year by the estimated average horsepower, then converting to kwhr with a reasonable allowance for motor efficiency. Few small mechanical-drive engines have any means for recording and totalizing the energy output.

Cost of Steam per Kwhr

Without specifically saying so, the discussion may convey the impression that the low costs listed are to be credited to the use of a particular form of steam prime mover. This may be true, to some extent, for the fixed charges. On the other hand, practically the same cost of steam per kwhr would be obtained with any other backpressure steam engine or turbine, regardless of make, type or efficiency, *provided only no exhaust were wasted.*

Finally, we should avoid leaving the impression that absorption of exhaust by process or heating invariably permits crediting the engine with the heat remaining in the exhaust. This credit is proper where use of the engine exhaust does not prevent the utilization of other sources of bled or exhaust steam. For example, if an auxiliary engine drive is used in connection with a condensing main-unit turbine-generator, use of engine exhaust to heat feedwater may prevent the use of bled steam for the same purpose. In such cases, proper energy charge against the engine must be more than the heat removed by the engine.

I would go a step beyond Mr. Vonachen in the matter of heat balance. He thinks it important to maintain heat balance, keep the available exhaust about equal to process and heating demands. I do not. I cannot see that total plant costs would be increased (unless the engine should cost more) if the use of a more efficient engine should cut exhaust to half the heating-process demand, so that the remaining half had to be supplied through a reducing valve.

Unless it adds too much to first cost, I think it better to design a plant *out of balance*, so that the expected exhaust will be less than the expected steam demand. This does not increase fuel consumption. At the same time it is insurance against possible waste of exhaust from future shifts in load balance.

In qualifying Mr. Vonachen's presentation with these many comments, I should again repeat *Power's* frequently expressed statement that true by-product power is often astonishingly cheap.

What Is An Engineer?

THIS question was asked not so long ago in an engineers' license examination. The question, and its possible answers, take on added interest in view of recent legal moves made in certain states. It is true that the word has been rather loosely used, but why all the furor? An engineer is employed for any position of responsibility only after thorough investigation of his past record.

"Licenses and papers of various sorts,"

Industry	Company	Location	Driven Machine	Kw.-Hr. per Yr.	Hrs. Operation per Yr.	Percent Load	Percent Exh-Steam Used	Power Cost at Shaft of Driven Machine: With Motor ¢ per Kw.-Hr.	Power Cost at Shaft of Driven Machine: With Engine ¢ per. Kw.-Hr.	Engine Power is — % Cheaper	Engine Investment Installed	Saving per Yr. over Motor Drive	Annual Return on Installed Engine First Cost: Above Motor Cost — %	Annual Return on Installed Engine First Cost: Entire Engine Cost — %
Artificial Gas	Roanoke Gas Light Co.	Roanoke, Va.	Exhaust Fan	52,900	8500	84	100	2.07	0.4	80	$715	$884	260	123
Ceramic	†	New York	Stoker	6260	6640	50	100	*	1.67	*	*	*	*	*
Distilling	Schenley Distillers Corp.	Lawrenceburg, Ind.	Rotary Dryer	1,112,000	7632	100	100	1.22	0.142	88	3000	12,056	5300	402
Food Mfg	†	Illinois	Stoker	9350	5000	67	90	*	0.98	*	*	*	*	*
Hospitals	Children's Hospital	Akron, Ohio	R Compressor	44,900	7300	100	100	2.21	0.46	79	755	788	187	104
Lumber	Cotton & Hanlon Co	Odessa, N. Y.	Kiln Fans	109,800	8400	75	100	1.065	0.221	80	1000	927	309	92
Utilities	Bloomsburg Heating Co.	Bloomsburg, Pa.	Stoker	12,100	6480	40	100	3.1	0.696	77	419	291	96	80
Oil Refining	Quaker State Refining Co.	Farmers Valley, Pa.	Blower	110,000	8640	75	100	0.97	0.342	65	1397	690	106	50
Meat Packing	Peet Packing Co	Chesaning, Mich.	R Compressor	152,000	5000	70	60	1.80	1.39	22	1780	640	264	36
Chemical	†	Maryland	Stoker	11,750	8280	35	100	*	0.91	*	*	*	*	*
Chemical	Stein, Hall Co	Chicago, Ill.	Draft Fan	20,800	3300	60	100	2.2	0.51	76	618	351	157	57
State Inst	State Training School	East	Stoker	8750	4420	42	100	*	0.936	*	*	*	*	*
Confectionery	Peter Cailler Kohler Swiss Choc. Co.	Fulton, N. Y.	F-D Fan	502,000	8760	100	75	0.88	0.325	63	1543	2773	1088	180
Tin Plate Mfr	Washington Tin Plate Co.	Washington, Pa.	F-D Fan	114,700	8700	50	None	*	0.552	*	*	*	*	*
College	†	Middle West	Draft Fan	35,500	4740	50	100	*	0.505	*	*	*	*	*
Iron	†	Middle West	Large Blower	2,520,000	8640	100	70	*	0.201	*	*	*	*	*
U. S. Gov	†	East	Stokers	25,750	6075	32	100	1.68	0.64	62	600	278	‡	46
Woodworking	Holgate Bros. Co.	Kane, Pa.	Generator	132,350	5110	67	100	1.133x	0.542x	52	x	780x	x	x
Woodworking	†	Michigan	Sawdust Conveyor	37,200	7000	80	100	0.955	0.333	65	512	231	74	45
Rendering Plant	Sioux Falls Rendering Co.	Sioux Falls, S. D.	Cooker	144,800	7800	91	90	3.05	0.517	83	851	3662	1830	430
Paper	†	Illinois	Draft Fan	52,700	7600	63	100	1.35	0.283	79	678	562	316	83
Hotel	Penn-Harris Hotel	Harrisburg, Pa.	R Compressor	128,800	7500	60	100	1.76	0.262	85	978	1930	§	197
Brewing	†	Middle West	Stoker	18,000	5000	61	100	*	0.57	*	*	*	*	*
Textile	Chatham Mfg. Co.	Elkin, N. C.	Draft Fan	15,350	1500	85	100	1.69	0.75	55	834	144	80	17
Dairy	†	Middle West	R Compressor	133,800	3600	100	98	3.11	0.466	85	1791	3531	800	197
School	†	Middle West	Ventilating Fan	18,000	1400	68	100	3.82	0.827	78	1160	539	90	46

* Purchased-power data not available.
† Company policy prevents use of name.
‡ Cost of engine less than that of motor.
§ Motor already charged off.
x Generating set compared with purchased power.

recently spoke the personnel director of a firm employing several hundred engineers, "mean little to me. If we find a man of our requirements and standards, he is employed as our engineer regardless—"

One state is reported to have a law making it illegal for the power plant engineer, the railroad engineer, or any other engineer to call themselves engineers unless they pass an examination and pay a fee. One question in a recent examination is reported to have dealt with designing a theatre lobby.

Fine and dandy for the engineer responsible for building design. But moments of inertia and radii of gyration in building design are quite different from coefficients of adhesion and draw-bar problems of the locomotive engineer. They are still different from staybolt stresses, heat-release problems, fuel analysis, safety-valve calculation, and electrical operation of the power-plant engineer.

Being Legal About It

From Webster's Dictionary, one may find without cost the definition of the word "engineer." Among the several definitions are: "One who designs or contrives, an inventor." "One versed in, or who follows as a calling or profession any branch of engineering." (Among the special branches are included structural, and power engineering). "One who manages or runs an engine, an engine driver."

A man who has completed his college course and field training in chemical engineering may be very competent in his field. Similarly, the mechanical engineer, who has designed and had charge of erection of steel and building material, should know his business. But, either one of them will undoubtedly admit that he may not be familiar with boiler design and problems of power-plant management.

Then, why pick on the mechanical engineer and tell him, because he may have specialized in structural planning and design, that he is not an engineer if he cannot test out a high-voltage circuit? And why tell the chief engineer who efficiently and safely changes every available Btu into kilowatts that he can't be an engineer until he designs the boiler-room roof?

It all seems to add up to a combination of childish politics and conceit over specialties. Such states that must enact laws to define the name "engineer" should recognize the many competent men in specialized fields, and not expect the ridiculous results from questioning many capable men in their own field about remote ones that they should not and do not intend to enter. Let us sectionalize the thing a little more if the majority of capable engineers feel that licensing and defining must be done at all.

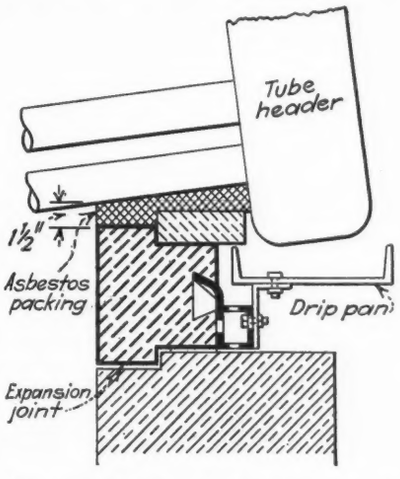
We now have engineers' license laws in many states and municipalities. These cover steam-electric-plant operation and supervision. Instead of trying to scramble all engineers' qualifications together, why not enact a separate code for licensing structural planners and designers, thus eliminating the difficulties and confliction of attempting to combine everything under one and the same code?

Canton, Mass. HARRY M SPRING

Protecting Boiler Box Headers

I READ the article by R O Billings, "Check Bottom of Box Headers," page 100, February *Power*, on the corrosion of box-header bottoms and heartily agree with Mr. Billings' comments. In my many years of masonry experience, I have many times detected excessive corrosion at the bottom of headers.

To overcome this condition, we have developed a drip pan and header protec-



tion to make the header accessible at all times for inspection. A seal inside the header, see figure, not only protects the bottom of the header from corrosion but also the tube ends where they enter the header, and at the same time permits free expansion.

Kansas City, Mo. GEO P REINTJES
Geo P Reintjes Co

Soot-Removal Compounds

[*The following two articles are additional answers to the question on copper chloride for soot removal, and supplement the answers that appears in March* POWER, *page 95*—ED]

SOOT removal from furnaces was thoroughly studied by the U S Bureau of Mines, and reported in Bulletin 360, which can be obtained from the Supt of Documents, Washington, D. C., for 10 cents (not stamps). This investigation showed that copper chloride gave the greatest lowering of the ignition temperature of soot deposits, of 12 metallic chlorides tried. Either cupric chloride ($CuCl_2$) or cuprous chloride (Cu_2Cl_2) may be used with equally good results. The cupric chloride is usually hydrated but this has no effect on the reaction.

Many other combinations were studied, many of which were almost as good and much less expensive. Mixtures of 50 parts copper sulphate and 50 parts common salt, or 20 parts cupric carbonate and 80 parts common salt give better results than salts or combinations other than the copper chlorides. Method of application is important, and furnace temperature and excess air must be watched, so Bulletin 360 should be consulted for these details.

Seattle, Wash. K A KOBE

CHEMICAL soot removers and chimney cleaners have been used persistently for many years without universal adoption or without abandonment. It may be reasoned, therefore, that there use apparently meets with some success, possibly under special conditions. Compounds range from simple chemicals, known by their ordinary commercial names, to those of a proprietory nature offered for sale under a secret formula.

The action of such chemicals, in all cases of apparent efficacy, is that of aiding natural purposes of soot removal. There is nothing magical in their behavior, sometimes claimed by makers of patented preparations. It has been shown that some materials, upon being volatilized or burned in the fire of a furnace, form vapor or smoke that will settle on soot deposits and lower the temperature at which that soot will catch fire. Moreover, soot once ignited in the presence of appropriate chemical fume will burn more vigorously and the total of deposits will be consumed more completely. For the action to be beneficial, sufficient temperature must be applied to the compound and to the unwanted deposits and excess oxygen made available in the flue gas.

A number of disadvantages or limitations apply both to the general process and to the use of copper chloride. Results are bound to be somewhat uncertain and can be consistent only where the action of the salts is fully appreciated and where they are used under the most favorable conditions of temperature, concentration, and excess oxygen provision. In application to a water boiler, it is possible that sufficiently higher temperature can never be obtained in gas contacting deposits to be removed. It is the writer's personal experience, moreover, that the effectiveness of any particular chemical depends very much on the nature of the soot deposit to be attacked, which in turn has a relation to the kind of fuel from which the deposit occurred.

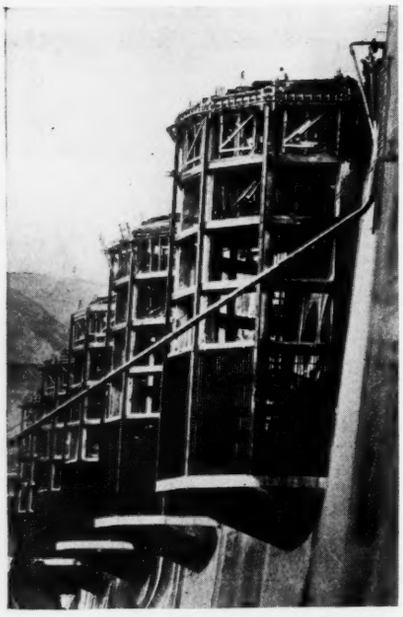
Corvallis, Oregon R E SUMMERS

Preventing Pitting in an HRT Boiler

IT MIGHT be much cheaper for EBW to sink a well, rather than endeavor to eliminate boiler pitting, mentioned in the article "Prevention of Pitting in an HRT Boiler," page 112, February *Power*. Zinc slabs placed in the boiler might assist in preventing pitting.

I have seen many boilers (where permitted by law) with perforated capped-end feed pipes through which feedwater is sprayed into the steam space without detrimental effects. It is also possible that the present water may be treated with sodium sulphite, which will materially assist in the arresting of pitting and oxygen corrosion.

Buffalo, N. Y. J J TIMMONS



—Photo Courtesy The Lincoln Electric Co

GRAND COULEE'S
BAY WINDOWS

360 of these bay-window trash racks, being installed at Grand Coulee Dam, are of all-welded-steel construction. Requirements were for tolerances of plus and minus ¼ in. in over-all width and length, and not more than ⅛ in. variation in over-all diagonal length and not more than ⅛ in. from a true plane.

STRAWS

Pointing the way business winds blow

ARKANSAS——Swift & Co plans boiler house at proposed new cottonseed-oil mill at Blytheville, where site has been acquired.

Artic Ice Co, Little Rock, Otis Nichols, head, plans 1-story ice-manufacturing and refrigerating plant, with initial capacity of about 40 tons per day. Cost $50,000.

CALIFORNIA——Dept. of Public Buildings, Sacramento, plans water-development project at Pacific Colony State Hospital, Spadra, to include pumping machinery and auxiliary equipment. Bids are scheduled to be asked in July. B McDougall, state architect.

Board of County Supervisors, Los Angeles, contracted R G Meyer, for furnishing and installing three 2500-sq ft boilers and auxiliaries for Olive View Sanitarium, at $33,300.

Board of County Supervisors, Los Angeles, will make improvements in power house at Los Angeles General Hospital, Mission Rd.

Feather River Pine Mills, Feather Falls (Butte County), A H Land, president, plans boiler house at new lumber and planing mill. Cost about $100,000. B Sewell, company engineer.

Anaheim Valencia Orange Assn, Anaheim, contracted Gay Engrg Corp, 2730 E 11th St, Los Angeles, for 2-story precooling plant at citrus-fruit packing house, to include 2-car icing dock, ice elevators, conveying system, etc. Cost about $70,000.

COLORADO——Westminster plans pumping plant for municipal water system, and will make purchase of equipment soon.

Bureau of Reclamation contracted General Air Conditioning Co, Sacramento, for air-cooling, ventilating and heating systems for Government camp at Shasta Dam, Central Valley project, at $17,280.

(*Continued on page* 126)

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Ark., Paragould—G. W. Hammond, city clk., soon lets contract remodeling present waterworks, power house building, concrete foundations for machinery, rein.-con. oil storage tank and atmospheric control tower; Sect. 2, diesel engine generating plant of two units, incl. switchboard station wiring, piping and auxiliaries; Sect. 3, complete electric distribution system, incl. meters, service connections, street lighting white way. Approximately $160,000. P.W.A. project. W. A. Fuller Co., 2916 Shenandoah Ave., St. Louis, Mo., engrs.

Calif., Glendale—City, preparing plans and specifications, under direction of P. Diederich, supt. of Plant and Production, Pub. Service Bldg., for constructing municipal steam generating plant. Est. $1,000,000 to $1,500,000.

Conn., Cromwell—Connecticut Power Co., 209 Court St., Middletown, plans extensions and improvements to Cromwell Substation. $300,000. Private plans.

Conn., Hartford—Hartford Electric Light Co., 266 Pearl St., plans brick, steel, concrete power station. $175,000. Private plans.

Conn., New Haven—New Haven Gas & Light Co., 80 Crown St., plans constructing plant improvements during 1938, here and vicinity. $130,000.

Conn., New Haven—United Illuminating Co., 128 Temple St., A. W. Kraft, pres., plans constructing extensions to power generating facilities at English Power Station. To exceed $150,000. Private plans.

Conn., New London — Connecticut Power Co., S. Ferguson, Jr., mgr. (New London Div.), 31 Union St., plans constructing power plant improvements and extensions. $250,000. Private plans.

Ia., Durant—Town, H. T. Diederich, clk., defeated bonds constructing light and power plant building and equipment. $100,000. **Maturity indefinite.**

Ia., New Hampton — City soon takes bids 2 diesel engines, one generating unit approximating 600 kw. capacity of from 800 to 900 hp.; and one generating unit of approximately 250 kw. capacity of from 375 to 400 hp.; cooling tower, fuel oil tanks; new switchboard panel; and necessary building changes to be used in improvement of municipal electric light and power plant. Est. about $100,000. R. W. Gearhart, 329-21st St. N.E., Cedar Rapids, engr.

La., Bossier City—City, c/o H. L. Fuller, mayor, held election Apr. 5 to vote bonds constructing municipal electric light and power plant and distributing system, incl. two 525 hp. and one 1,000 hp. engines, either Diesel or electric. $350,000. Garrett Eng. Co., 308 Hughes St., Houston, Tex., and c/o owner, engrs.

La., Ville Platte — City plans election to authorize construction of municipal light and water plant. F. P. Joseph, Glenmora, engr.

Mass., Boston—Commonwealth of Massachusetts, State Superintendent Buildings, Boston, plans altering power plant in state house, Beacon St. $51,000. Engineer not appointed.

Mass., Holyoke—Holyoke Water Power Co., 1 Canal St., seeking capital stock increase of $3,000,000 to provide funds for constructing plant extensions and improvements, to include 10,000 kw. steam turbine, oil burning system, and extensions to steam heating system, also additions to protect plant above 1936 flood level. Private plans.

Mass., Malden—New England Power Service Co., 441 Stuart St., Boston, rebuilding 1 story, present boiler house and purchase equipment for switch house, Centre St., by separate contracts. To exceed $40,000. Private plans.

Mich., White Pigeon—Eddy Paper Corp., Three Rivers, plans improvements to power plant and paper mill. $300,000.

Minn., Eveleth—City, c/o D. Jerome, clk., may hold special election to vote on authorizing construction of power plant, generating equipment, and electric distributing system. $850,000. City has assurance P.W.A. grant is still available. H. Sholund, city engr.

Minn., Glenwood — City defeated $200,000 bonds for constructing power plant, generating equipment and electric distributing system. P.W.A. project. F. P. Schaub, city engr. Burlingame, Hitchcock & Estabrook, 521 Sexton Bldg., Minneapolis, engrs.

Miss., Columbus—City, c/o Clerk, making plans constructing electric distribution system, incl. trunk line connection with TVA system, local lines, sub-station transformer, etc. $280,000. Beard Eng. Co., 2606 Oakview Terrace, Maplewood, Mo., engrs.

Mo., Kennett—S. G. Fisher, city clk., soon lets contract for Contr. 1, diesel power plant equipment, incl. two 400 kw. or three 250 kw. engines; Contr. 2, power plant building; Contr. 3, electric distribution system. $170,000. P.W.A. project. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

N. Y., Albany—City, City Hall, plans application for Federal grant at once to finance construction of municipal electric power plant. To exceed $500,000.

N. Y., Buffalo—Buffalo Niagara Electric Corp., Electric Bldg., Seneca St. and Bailey Ave., plans constructing new terminal station, about 500 ft. square. $1,500,000. Private plans.

N. Y., Buffalo—City Council plans constructing city-owned and operated electric generating power plant. To exceed $500,000.

N. Y., New York—New York Edison Co., 4 Irving Pl., plans altering 7 story, electric power plant, 320 West 201st St. $250,000. T. R. Galloway, c/o owner, engr.

O., Greenfield — Village Bd. Trustees P. Affairs, W. B. West, clk., soon lets contract furnishing, erecting one 1,000 kw. turbo-generator unit, complete with generator, air cooler and accessories; one surface condenser, complete with circulating pump, condensate pumps, pump drives, air ejectors and accessories; one 25 kw. turbine driver, exciter unit, complete with all accessories; furnishing generator panel, complete with oil circuit breaker and instruments and one generator voltage regulator panel with accessories, swinging bracket and 3 feeder panels, complete with accessories, all above for water and light plant. W. D. Barrows, Ribold Bldg., Dayton, engr.

Okla., Hollis—City defeated bonds for constructing municipal light plant. $135,000. V. V. Long & Co., Colcord Bldg., Oklahoma City, engrs.

Pennsylvania—U. S. Eng., Federal Bldg., Pittsburgh, making plans constructing 950 ft. gravity type concrete dam, 130 ft. high, incl. 15 kw. power plant for dam operation, Red Bank Flood Control Dam. $3,000,000. W. E. R. Covell, Federal Bldg., Pittsburgh, ch. engr.

Tex., Hempstead—City, J. C. Calhoun, secy., sketches constructing electric light and power system and plant. $90,000. Held election Apr. 5 to vote on type of system. Engineer selected soon.

Tex., Houston—Houston Lighting & Power Co., 1016 Walker St., plans constructing improvements and expansion to power stations $1,549,963, expansion of distribution facilities $685,045, expansion of transmission facilities $109,000, expansion of substation facilities $101,656, new meters $175,000, new transformers $100,000, rural extensions $75,000. New automobiles $52,500, and miscellaneous $28,500. More than one-half of the money to be expended will go for new 25,000 kilowatt turbine at Gable Street plant of HL&PCO here.

Tex., Sonora—City, c/o W. C. Gilmore, soon lets contract furnishing and installing 400 gal. per min. deep well turbine pump and motor. $4,000. H. F. R. Helland, 503 Frost Natl. Bank Bldg., engr.

Virginia—Virginia Electric & Power Co., 7th and Franklin Sts., Richmond, A. H. Hermann, public relations dir., approved $2,500,000 construction budget, consisting of power station improved equipment, mostly for Reeves Ave. Station in Norfolk, $650,000; high tension transmission line from Richmond to Petersburg, $140,000; additional rural lines, $175,000; new motor buses, $245,000; miscellaneous line extensions, $1,250,000.

Wash., Seattle—J. R. Ummel, purch. agt. Alaska R.R., Federal Office Bldg., Seattle, Wash., soon lets contract constructing power plant at McKinley Park Hotel, Alaska, involving 2 single-cylinder, automatic, horizontal type steam engines with extended shafts for direct connection to alternating current generators with belted type exciters. One engine will drive a 50 kw. unit, the other 100 kw. unit of 60 cycle, 3 phase, 4 wire, 120/208 volt type.

Quebec—National Syndicate of Quebec, c/o S. A. Baulne, pres., Montreal, was authorized by Provincial Government to build 2 or more central electric power plants in Abitibi and Temiskaming Districts. $10,000,000. Government also plans to allow construction of other plants whenever the need exists.

Que., Chelsea—Gatineau Powers Co., Ltd., 140 Wellington St., Ottawa, Ont., soon takes bids installing additional 60 cycle, 34,000 hp. generating unit at plant on Gatineau River, 6 mi. from here. This makes the fifth 34,000 hp. unit and will complete that station to its full designated capacity of 170,000 hp. $450,000. Private plans.

Manchoukuo, Hsinking—Talu River Hydro-electric Co. plans constructing dam at Suihodo, est. to cost 100,000,000 yen and power station to generate 640,000 kw. of electricity, power plants will also be constructed at Gishu, Igen, Shuan, Jigo, Rinko and Kogen on upper reaches of Yalu River, bringing generation up to 1,600,000 kw. of electricity. Equipment for Suihodo station will include 7 hydraulic-turbine generators, each of 92,000 kw. capacity.

"Engineered the Power Plant Way"

MAKES C-H VALVE UNITS TODAY'S CHOICE

ENGINEERS agree that efficiency in power generation carries us steadily toward higher temperatures. But temperature "heights" depend on man's ability to handle them.

The extraordinary care with which Cutler-Hammer valve operating units are built, their characteristic "power plant engineering" are directly in line with the pattern laid down by Power Plant Engineers. Once this comparison is made, it is easy to understand the almost universal preference for Cutler-Hammer valve operating units. CUTLER-HAMMER, Inc., Pioneer Manufacturers of Electric Control Apparatus, 1209 St. Paul Avenue, Milwaukee, Wisconsin.

PHOTO COURTESY BUREAU OF MINES

CHECK THESE EXCLUSIVE CUTLER-HAMMER FEATURES

SPECIFIC METALLURGY. Steam temperatures of 900° and above eliminate the possibility of haphazard choice of valve materials. C-H units also employ the specific alloy and treatment best suited to the function of each part. Write for specifications.

MOTOR INSULATION. C-H valve unit motors have class B asbestos and mica, flame-proof insulation, standard for a 75°C rise.

AUTOMATIC DISENGAGEMENT. To "brake" an operating unit on the valve seat would subject the valve to heavy strains. Therefore, C-H employs automatic disengagement of driving unit at exact moment of seating. Driving unit then runs free until its inertia is spent.

TIGHT SEATING OR POSITION SEATING. Some types of valves demand tight seating. Others properly should be position-seated. C-H valve control provides either method.

READY ALWAYS FOR MOTOR OR MANUAL OPERATION. For a power plant valve operating unit to fulfill its purpose, it should be immediately operable either by hand or by motor. In C-H units, neither type of operation can interfere with the other. Remote control is always available in case of emergency.

CUTLER-HAMMER

VALVE CONTROL

C-H

Practical Aids to Operation

Improvising a Reamer for Cylinder Block

OVERHAUL of an oil-field pumping engine required new pistons and rings. Although of the specified diameter, none of the replacement pistons would enter the bore, this difficulty being traced to shoulder of metal left above the topmost limit of ring travel. Without adequate tools for boring out this excess metal, and no files on the job save flat ones, serious delay in reassembling was avoided by making a reamer, utilizing as its base a discarded piston.

Four slots were cut into the top of the piston toward its center, a hacksaw blade being used which was so well worn that practically all of the rake of the teeth had been removed. Into each of these slots was set a short section of a tough hacksaw blade, retained by a notch ground into the blade and a discarded piston ring snapped into the notch, as in the figure.

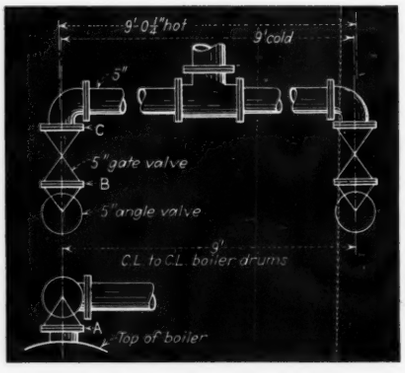
Four sections were inserted into the piston and ground on a portable grinder tangent to the piston at the top, and tapered out to project $\frac{1}{8}$ in. halfway to the first ring groove. By inserting the improvised reamer upside down in the bore, and rotating slightly by pins in the connecting-rod holes, excess metal was cut away to give a slight flare to the top of the cylinder. This taper made it easy to insert each piston with its complement of rings.

The original reamer proved so useful that another, more carefully worked out, became a part of the engine-overhaul kit. In it, the four slots were spaced so that no pair fell exactly on a diameter of the piston, and so that there was about a 3 deg cant-back away from the normal direction of rotation. Reamer cutters made from tungsten steel stand up well, whereas those made from hacksaw blade snap if the reamer is fed too rapidly.

Longview, Texas ELTON STERRET

Remember Flexibility in Piping Systems

We are not very likely to forget that expansion of 100 ft of pipe may be several inches, but are too prone to assume that expansion of 100 in. of pipe can be safely ignored. If 100 ft expands 3 in., 100 in. will expand 0.25 in. with a force quite sufficient to crack fittings, shear bolts, and generally wreck anything that opposes it. Although connections are seldom made without some regard to expansion, we often see them made with such short



nipples that we are almost tempted to believe the designer thought that there was some spring in cast-iron fittings.

The figure illustrates a rather extreme case, which has a deceptive appearance of flexibility, but careful inspection will show that this does not really exist. It is true that 0.25 in. is a small distance, but unless the boilers shift, or the flanges slide on each other, it is difficult to see how even half this can be taken up.

The angle valve might turn slightly at *A* (due to bolt clearances) and the short horizontal lengths of 5-in. pipe might possibly bow slightly. Stress necessary to bring this about would be enormous and most of it would be transferred to the flange joints at *B* and *C*.

It may be advisable to install a short nipple between the flanges at *A*, which would enable the angle valve to turn on a vertical axis. Unless the flanges are Van Stoned, they will work on the pipe threads, which is bad medicine if we want tight joints.

The proper thing to do is to insert pipe sections at *B* or *C* of sufficient length to give the necessary flexibility without creating undue strains in the joints or fittings. This case is typical of conditions which may occur in piping systems if care is not taken in design. Leaky joints and cracked fittings always have a cause, and as often as not, the real fault lies in the piping layout, rather than in defective castings or poor workmanship.

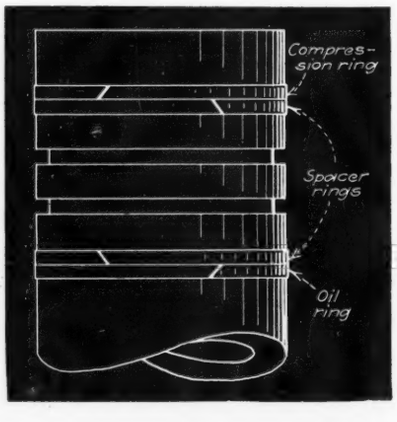
Bloomfield, N. J. J O G GIBBONS

Changed Piston Rings Solve Diesel Problem

Two 6-cyl, 150-hp diesels driving centrifugal pumps carried their 15 to 25% overload satisfactorily a short time after installation, but soon developed symptoms of power loss. Compression test and crankcase-oil inspection indicated serious blow-by. Piston rings were replaced and again there was ample power for a short time. "Miking" rings and pistons showed that rings had worn away shoulders of aluminum pistons, and that the power loss was due to blow-behind instead of blow-by.

Lands on the pistons were so narrow that it was not considered advisable to widen their grooves to permit placing all four rings above the pin boss. Instead, the two inner grooves were refilled with aluminum, using ordinary welder's equipment on carefully preheated pistons. These grooves were then refinished in the lathe, to accommodate the standard width and thickness of ring as furnished by the diesel builder.

The top grooves, showing the great-



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1. ***Valve and seat stainless steel, heat-treated***—to practically eliminate wear at the only point where wear could possibly occur. (Same valve seat for all pressures without change.)
2. ***Bright cadmium-plated cold rolled steel body***—this protective plating *inside and out* gives a durable, rust-free finish to match the strength of the rugged bar-stock body.

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Here is all there is to a Yarway Impulse Trap.

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(B) Valve (stainless steel, heat-treated).
(C) Valve Seat (stainless steel, heat-treated).

NO levers, pins, cotters, floats, buckets, diaphragms or bellows.

Yarway's position of leadership in the development of high quality steam specialties has been continuously maintained for over a quarter century, because—no matter how well a Yarway product is regarded by its users, it is never considered "perfect" by Yarway engineers.

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IMPULSE STEAM TRAP

est wear both behind ring and on the sides, were widened toward the next narrow land just enough to give a square face, and then carried upward toward the piston head far enough to give a slot double the original width, and of uniform depth. The same reworking, but in this case proceeding downward toward the skirt, was given the bottom or oil ring. New oil-drain holes were drilled at the bottom of the new groove. Into these double-width grooves were put a standard compression and a normal oil or scraper ring, as in the figure. To fill the remainder of each groove, a standard width ring, made to contract instead of expand by peening on the outer surface, was used. These dummy or spacer rings left only normal designed ring friction against cylinder walls, limiting wear at that point, and in no way hampering the working of the ring to follow wall contours.

Although space between the outer surface of the spacer rings and cylinder wall filled with carbon, engines operated up to the scheduled overhaul period without appreciable loss of power. Where spacer rings are used (see illustration), the dummy should go below the compression ring, and above the wiper ring, to absorb the greatest wear of the working ring, and to maintain the desired seal effectively.

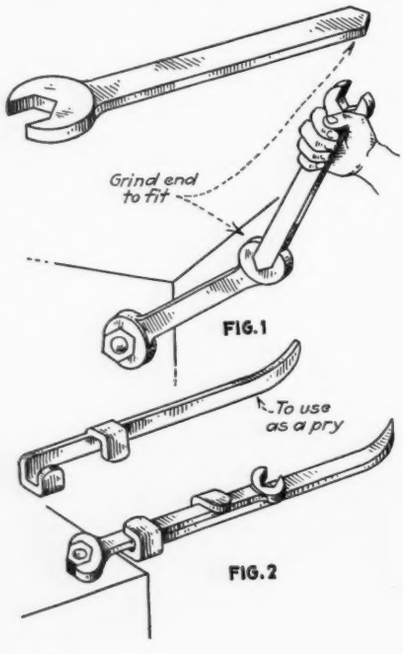
Longview, Texas M T PATE

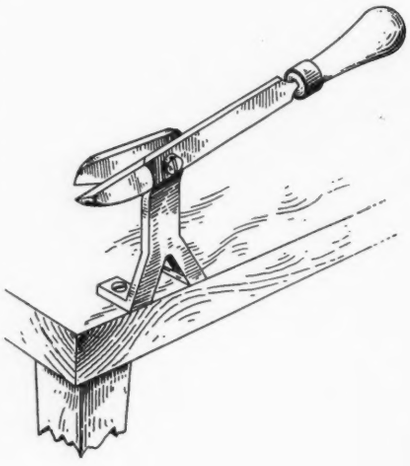
One Wrench Aids the Other

PLANT-repair men, mechanics and engineers can add this one to their notebook. It is certainly a simple idea, but, none the less, a handy one. By grinding the end of the handle of a straight open-end wrench, Fig. 1, it may be used as additional leverage on a double-end wrench. With this gadget, one doesn't have to hunt for a piece of pipe.

For double-end wrenches, where one wants to forge up such tools, the pry bar and wrench lever, Fig. 2, will be found well worth the labor and material used to make it. The bar can be made in a size that will fit a wide range of wrenches.

Boston, Mass. J W ROGERS





Bench Shear Made from Old Files

WORN-OUT files can come in handy sometimes, if made into a work-bench shear. A design for such a tool is shown in the figure. The bench or stationary jaw is made with a little offset and the leg split to provide two well-spread supporting feet. It is not at all difficult to forge this form, if one will be patient about the heat and remember to keep the metal good and red in working it. The moving jaw is but a matter of piercing the bolt hole and grinding properly.

Penacook, N. H. C H WILEY

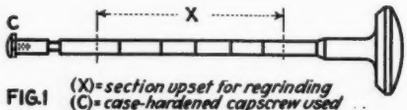


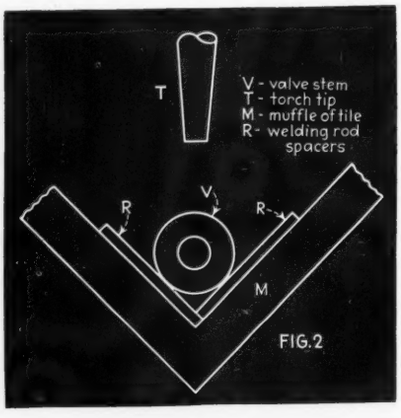
FIG. 1 (X) = section upset for regrinding
(C) = case-hardened capscrew used to restore original stem length

Swaging Reconditions Scored Valve Stems

FAILURE of a cooling-water system while the graveyard shift was indulging in too much holiday spirit all but ruined four internal-combustion pumping engines in a South American pipeline station. After the units had cooled down enough to permit examination, it was found that the splash-oiling system had saved everything it could reach, but that valve stems and guides were scored, warped and in some cases seized, and that wholesale replacement was necessary.

New valves and guides for solely one unit were available, and even airplane delivery of new parts would involve a week's delay. Valve stems could have been built up by welding with proper equipment, but skilled welders were not among our assets. Lacking the welding technique, we decided to try upsetting or swaging the stems, Fig. 1, to provide material enough to allow a light cut and the necessary grinding to give a good fit.

To do this work, valve end of the stem was securely held in a cup-shaped depression in the end of a heavy timber, braced against a concrete wall. Against the other end of the valve stem was set a hydraulic jack, also securely braced. By setting up on the jack, pressure could be exerted axially on the valve stem. A muffle was made from a corner of a hollow building tile, and 2-in. spacers cut from $\frac{1}{4}$-in. welding rod held the stem clear of



the muffle walls, Fig. 2, to allow heat from the welding torch to encircle and heat it more uniformly.

With jack pressure on, a short section of the stem was brought to a low cherry red, and the heat gradually increased until the red-hot section was slightly upset or enlarged by the pressure acting through the stem from the jack. The enlarged section thus started was carried along the entire 13.5-in. to be worked over, and the flame moved back and forth along the stem to provide additional upsetting as calipering showed the diameter to be under that desired. Carrying the welding torch flame high in acetylene, a carburizing heat was obtained, reducing scale formation to a minimum.

After a pair of valve stems had been spoiled in acquiring the skill necessary to upset the $\frac{7}{8}$-in. round rod evenly, work progressed rapidly. Stems were shortened on an average of less than a full inch to bring diam-

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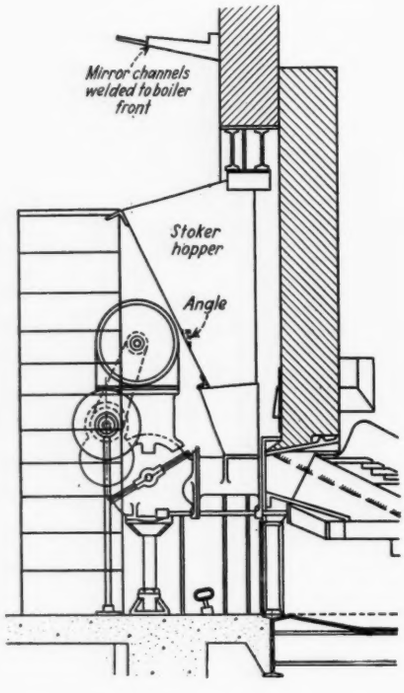
eter up from the nominal $\frac{7}{8}$ to $\frac{29}{32}$-in. This provided enough metal for the truing cut in the lathe, followed by grinding with a tool post grinder while still between lathe centers.

To compensate for stem shortening through upsetting, a cap screw was case hardened on the head and screwed into tapped hole in the valve-stem end. Substitution of this cap-screw for the usual rocker-arm contact maintained original valve seat to rocker arm measurement.

Reaming of the cast-iron guides was sufficient to restore them to service, as most of the damage was on the steel stem. Only one of the 32 valves replaced—27 of them being upset as outlined—failed in service, and no others were replaced until valve wear required it, although an ample supply for repairs was on hand long before the need arose.

Kilgore, Texas C C LYNDE



Mirrors Show Level in Stoker Hoppers

THE diagram shows how a mirror was installed to check stoker-hopper coal supply. During cold weather, our large boilers are operated at fairly high ratings to supply steam to turbine-generators and also to a district-heating system. Climbing the ladders to the stoker-hopper observation platform became quite tedious during such periods. The mirror, of the dime-store variety, is held in place by two small bent channels spot-welded to the steel boiler front.

A further refinement consists of welding a small angle iron in the hopper at a depth corresponding to the point where the hopper will just take a full load from the weigh larry. Our stokers, being 8 retorts wide, require 2 mirrors per stoker.

Hibbing, Minn. A L BENNETT

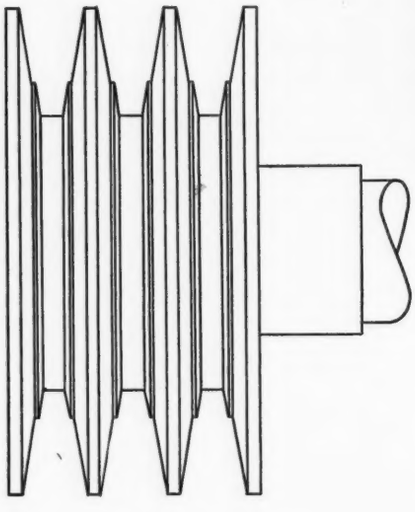
Remove Scale to Prevent Cylinder-Head Cracking

WELDING a cracked diesel-cylinder head puts it into working condition, but does not remove cause of the failure. If scale caused the trouble, welding will not prevent recracking. If a boiler tube fails because of scale, when we renew the tube we clean the boiler; similarly, when we weld a cylinder head it should be cleaned.

For this work I use a 50-50 solution of muriatic acid and water, which can be poured into the cylinder head after welding and let stand until all scale is removed. Many engineers recommend a 1–10 solution and allow it to stand for 24 hr, but I have never found the stronger solution harmful. I have used even stronger mixtures without causing any apparent harm.

Because one cylinder head cracks, don't wait for more of them to become eligible for the welding shop. Find the cause, prevent scale formation by treating the cooling water, and clean all cylinder heads with acid solution.

Barranquilla, Colombia, S. A.
C A VAN DEURSEN



Worn Sheave Injures Multiple-Vee Belts

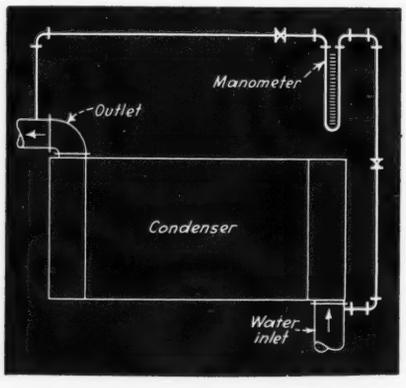
IN A hospital power plant, a multiple-vee belt on an ammonia compressor enjoyed only short life. A new set of belts showed damage and wear within several months. Inspection of the small sheave revealed noticeable wear on each vee, which left a distinct shoulder at the belt depth, shown exaggerated in the figure. Truing the vees to their full depth cured the trouble.

Chicago, Ill. R O BILLINGS

Manometer Indicates Condenser Cleanliness

CONDENSERS serving extraction turbines are ordinarily built with sufficient heat transfer to handle full-load steam of the turbine when operating straight condensing. Because the condenser is operating at only a small part of its rated capacity, it frequently receives scant attention and gets very dirty before vacuum is effected or an appreciable increase in circulating-water pressure indicates necessity of cleaning. This neglect may cause serious difficulties if it suddenly becomes necessary to operate straight condensing.

Any obstruction in condenser water passages increases pressure drop across it, even at very low circulating-water flows. Taking advantage of this, the engineers in a large industrial power plant determine condenser cleanliness with a mercury manometer. This instrument connected to the inlet and outlet circulating-water piping, as in the figure, indicates slight differences in pressure that are impossible

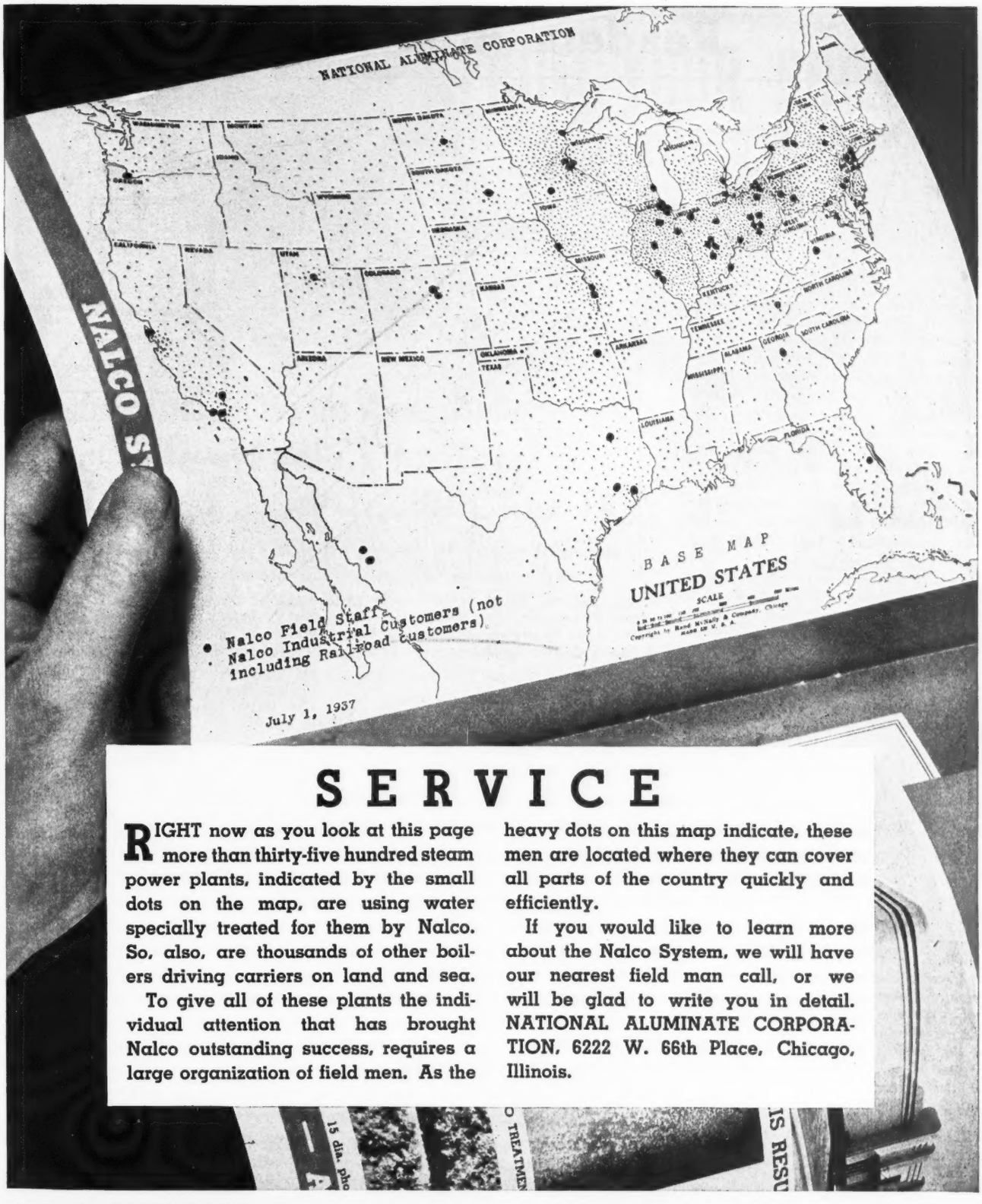


to detect on the usual bourdon-tube gage.

When the manometer was installed, tests were made with the condenser clean, using fixed steam and water quantities. These results were recorded. Then, by duplicating these quantities and noting the differential pressure increase on the manometer, degree of condenser fouling is easily determined. The allowable increase in differential pressure before cleaning is desirable was determined by experience. Tests were made at different loads so that conditions could be duplicated during ordinary operation without changing the load on the machine.

To prevent the mercury in the manometer spilling over into the condenser and destroying the tubes by amalgamating with metal, the connections were made to the circulating-water lines rather than to the water boxes.

Roanoke, Va. S H COLEMAN



SERVICE

RIGHT now as you look at this page more than thirty-five hundred steam power plants, indicated by the small dots on the map, are using water specially treated for them by Nalco. So, also, are thousands of other boilers driving carriers on land and sea.

To give all of these plants the individual attention that has brought Nalco outstanding success, requires a large organization of field men. As the heavy dots on this map indicate, these men are located where they can cover all parts of the country quickly and efficiently.

If you would like to learn more about the Nalco System, we will have our nearest field man call, or we will be glad to write you in detail. NATIONAL ALUMINATE CORPORATION, 6222 W. 66th Place, Chicago, Illinois.

ANY WATER **NALCO SYSTEM** ANY PRESSURE

Inquiries other than domestic, *except those from U. S. Possessions, Canada and Mexico,* should be addressed to ALFLOC LTD., Bush House, Aldwych, London, W. C. 2, Eng. Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

Readers' Problems

Questions *for Our Readers*

Coal Segregation

Question 1

We are having considerable segregation in our 5-retort underfeed stoker. The layout of the coal-handling system is illustrated. Retorts on either side receive coarse coal and the retorts in the center get fines. This results in very unsatisfactory burning conditions. We are satisfied that the main segregation takes place at the hopper, but are not sure of the best way to prevent it. It is impossible to raise the scales so that limited head room makes it difficult to install a conical feed chute, and we are somewhat skeptical as to the efficiency of vanes.

Our idea is a screw conveyor in the chute immediately above the stoker hopper, would make it possible to spread the coal over the length of the hopper. Of course, the screw conveyor would be divided into right and left hand in the center. Would it be necessary to have a trough under the conveyor with suitable openings above each retort? What would be the most satisfactory location of the screw conveyor? We would appreciate receiving the opinions of POWER *readers on these points, and suggestions as to other possible solutions.—GAS*

Air for Spray Masks

Question 2

Our single-stage air compressor takes air from the engine room and unloads at 100 lb. The receiver is also in the engine room. Air for spray guns and the operators' masks is taken from this system. We are having trouble with oil and moisture in the guns, but mostly in the masks. I would like to know whether it is practical to use this air for the masks and if it is harmful to the operators.—PP

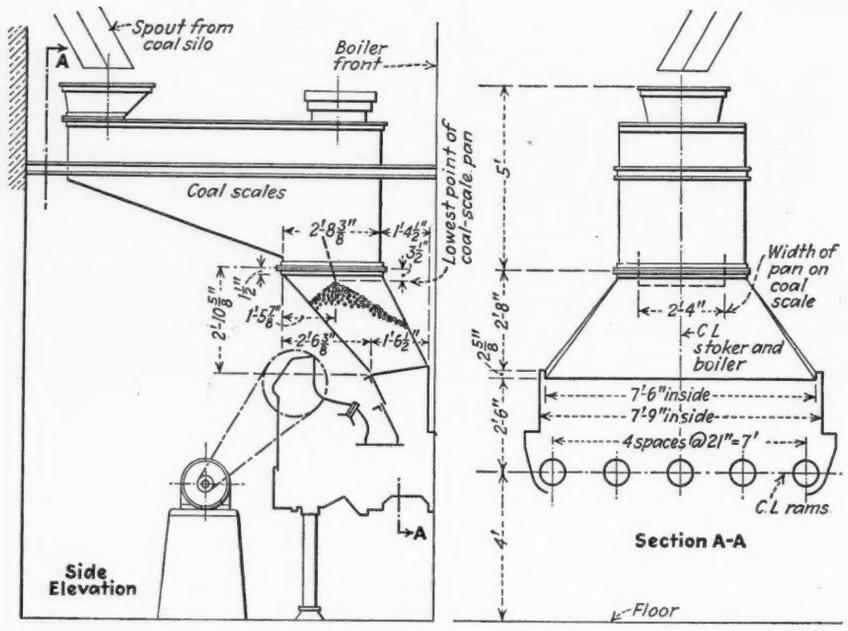
Suitable answers from readers will be paid for if space is available for publication.

Slag Removal

Answers to March Question 1

The Question

Have any Power readers had experience, successful or otherwise, with slag removal or slag prevention through use of proprietary slag removers or other compounds such as calcium chloride, molybdenum sulphide, etc? We intend doing something about our slagging problem, but would like to know what experience others have had before making a definite attack.—TBS



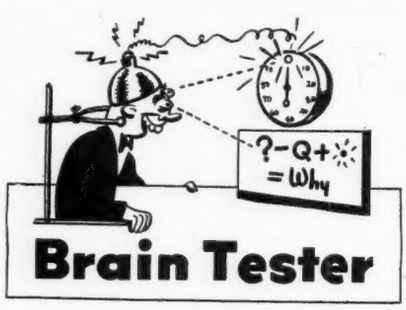
Hand Water Lance

OUR EXPERIENCE with deslagging has been quite extensive and has been generally confirmed by other engineers who have faced the same problem. Most effective means of removing slag while boiler is in operation, is the hand water lance which shoots slugs of water by means of compressed air. Steam can be used if no compressed air is available but it is more difficult to handle. Such a lance can remove slag faster than the stoker will carry it away.

The most popular way to make a lance is from a gun designed for shooting plugs through condenser tubes. To this is added about 10 ft of pipe with a water connection near the gun. Install a valve to restrict water flow. With 50-60 lb air pressure available, the operator will soon learn to do a thorough job with a minimum of "shots". A quick opening valve will serve if no gun is available, but is not quite as handy.

A method that is more convenient but more expensive and somewhat limited in range, is the automatic deslagger which works on the same principle as the soot blower except that it uses water to remove the slag. Many of these are in successful operation.

Bound Brook, N. J. W ROHRHURST



Sharpen your wits on this little problem, then check your answer with the one given on page 126.

THE STUDIOUS CHIEF AND THE BOOKWORM

The chief had three handy reference books on a shelf convenient to his desk. They stood in order, Vols. 1, 2, and 3. Each cover was ¼-in. thick and the pages in each totalled 2 in. While the chief was busy trying to keep the plant running, a technically-minded bookworm ate his way from the first page of the first volume to the last page of the last volume. How far did he travel?

Air-Conditioning Controls

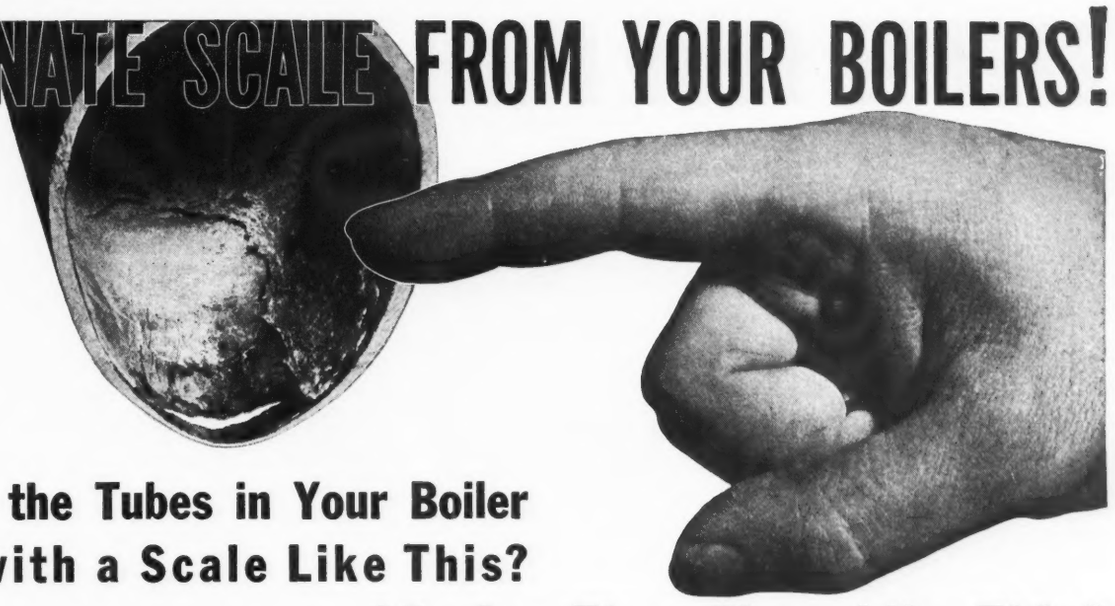
Answers to March Question 2

The Question

We are thinking of installing an air-conditioning system in a restaurant. We want to have it running by summer so have to move fast. What I want to know is how much control is actually needed for this job. In the preliminary plans everything is controlled—tonnage, amount of bypass air, wet bulb and all the rest. The cost of the control equipment to do all this is a fair sized share of the total cost. Isn't there some sim-

(Continued on page 124)

ELIMINATE SCALE FROM YOUR BOILERS!



. . . Are the Tubes in Your Boiler Lined with a Scale Like This?

. . . . . OR, Are They Clean Like This?

The economy of a boiler depends upon its continuous hard work. Do you know that scale no thicker than 1/100 of an inch, formed at the hottest part of a boiler tube, may lead to costly destruction and outage?

The upper photo shows a boiler tube that has become overheated. Because a thin scale formation on the inside of the tube acted as an insulation, the water could not carry the heat away fast enough. Result: The heat made the steel so soft that the pressure of the water pushed it out like rubber until finally it "blew out" as shown in this actual photograph.

When water conditioning is not correct, scale formation often occurs during even short periods of time. It usually occurs where the heat is the greatest—where the heat should be carried away freely. Amazing, too, is the fact that even a little scale can cause dangerous increases in the temperature of the tube wall that it covers.

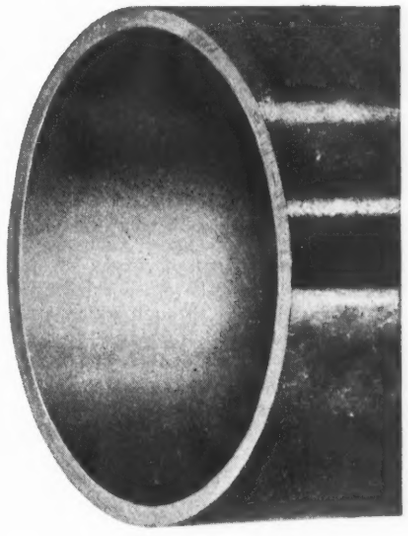
Such areas may be very small, or they may extend over the entire length of the tube. In any event, the result may (and usually does) lead to destruction and outage! Play safe—eliminate scale!

Correct conditioning of boiler water prevents scale formation and its subsequent losses. And it eliminates scale formations that have already begun to form.

To provide correct boiler water conditioning—to provide economy and security of plant operation—is the job of The Buromin Company, working in connection with Hall Laboratories. That is the job that our engineers are doing in power plants—large and small—everywhere.

The years of successful experience of these engineers are at your service. Their knowledge, gained in correctly conditioning every known type of boiler water, is subject to your call. Let them consult with you to help you protect your plant against boiler water troubles.

THE BUROMIN COMPANY, 300 Ross Street, PITTSBURGH, PA.



Scale is only one of the evils that develops in boilers. Other evils that are costly or destructive are pitting, embrittling and carry-over. The Buromin Company corrects and eliminates all of these evils with equal thoroughness.

BUROMIN

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Gentlemen:

Please send me, without obligation, your booklet "Buromin—for clean boilers, continuous service, enduring economies, lasting satisfaction."

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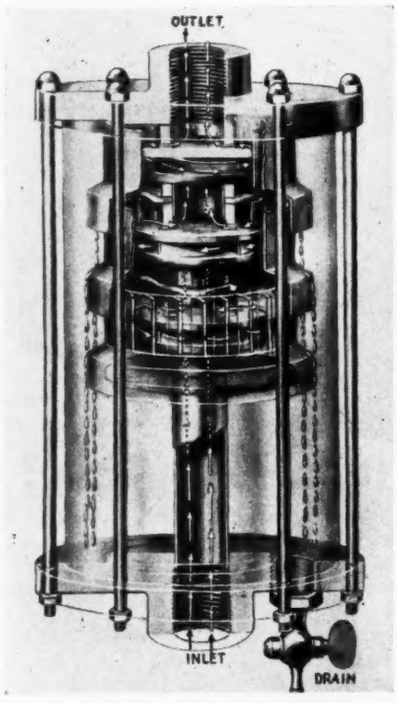
What's New in Plant Equipment



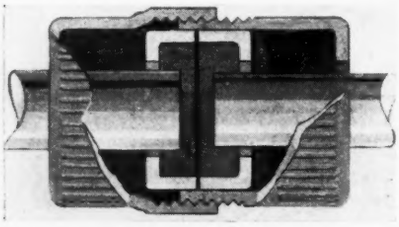
Centrifugal Separator

FOR CLEANING and drying of compressed air, gas or steam, this unit weighs 15½ lb. Mounted one above the other are three internal vaned units through which air, gas or steam must travel in succession before it can issue at top connection. Each of these units sets up rapid whirling movement as long as there is passage through separator. Whirling throws moisture and dirt outward from center. At same time, flow is caught by additional sets of vanes curved in opposite direction and secured to overlapping sleeves inside housing. Reversal following centrifugal action causes moisture and dirt to strike inner surface of cups, from where they drop to a collection chamber. For pipe sizes to ¾ in.

Textite Corp, 2110 Roscoe St, Chicago.

Flexible Coupling

"TORFLEX" coupling transmits power from driving to driven shaft through rubber bushings which are bound by pressure to shafts. Provides full power trans-

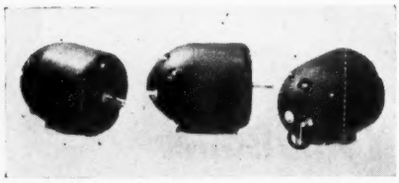


mission, even when shafts are in great angular or parallel misalignment. Made for shaft sizes up to 1½ in. in diameter.

Gordon Engineering Co, 3576 Gratiot Ave, Detroit, Mich.

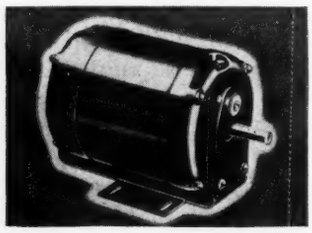
Motors

OF TWO motors described here, first, illustrated immediately below, is shaped to blend with usual fan or air-circulator design. Has barrel frame to facilitate mounting in ring or yoke. Built with split-phase windings for 1150 or 1725



rpm with start-and-stop pull switch; with windings for two speeds, 860 and 1140 or 1140 and 1725 rpm with 3-position pull switch; also to operate with separate transformer capacitor control to run at two or three speeds. Made in sizes of ⅛, ⅛ or ¼ hp to operate fans from 20 to 32 in. in diameter.

Second motor, a belt-tightening unit for over-drives, is supported above and

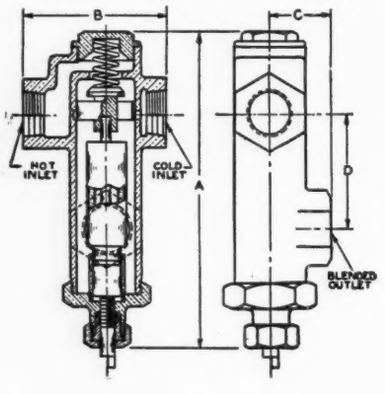


off shaft center so its own weight provides initial belt-tightening effect. However, this is increased proportionately to load by reaction of rotor to stator, causing motor to swing away from its load and tighten belt proper amount. Also made as belt tightener without springs for under-drive belts.

Ohio Electric Mfg Co, 5914 Maurice Ave, Cleveland, Ohio.

Water Blender

THREE-WAY thermostatic valve, operating on liquid-expansion principle, has four ports, two for each inlet. It is piston type, with all four valve seats exactly same diameter. Relief spring prevents damage to thermostat from over expan-

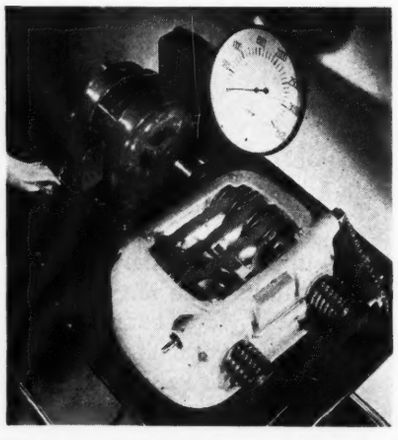


sion. Overheating up to 50 deg beyond calibrated temperature will not injure it. Special blenders can be furnished for temperatures as low as 0 F or as high as 300 F. Standard Type DB blender has a range of 140 to 180 F and can be adjusted over this range by a key. Made in sizes ½ to 3 in.

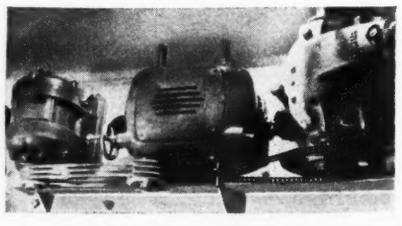
Sarco Co, Inc, 183 Madison Ave, New York, N. Y.

Vari-Pitch Speed Changer

"TEXROPE" unit consists of a pair of shafts on which are mounted two grooved vari-pitch sheaves adjusted through a worm-and-worm wheel.



Can be operated at high speed, permitting direct-connected motor. This totally enclosed unit, with double-shaft extensions and driven from a standard motor, provides flexibility that makes it adaptable to a wide variety of layouts. Where change in speed is to be adjusted manually only, unit has accessible hand-wheel control. However, it can be equipped with either electric or manual remote control. Made in seven sizes, covering range of 1 to 33 hp, with speed range of 3.75 to 1, and between



300 and 3600 rpm. Second photo shows speed changer applied to machine drive.

Texrope Div, Allis-Chalmers Mfg Co, Milwaukee, Wis.

Potentiometer Controller

RESET potentiometer controller for continuous processes combines Bristol "Pyromaster" potentiometer temperature-measuring system and reset "Free-Vane" air-operated control mechanism. Temperature-measuring system is electrical, operating on potentiometer principle. Reset air-operated control mechanism

Because the new COPES

FLOWMATIC

has demonstrated

—close boiler water level control on rapid load swings

—accurate feed flow control

—trouble-free operation

—low maintenance costs

more plants have selected it in its first year than had selected any other steam-flow type feed water regulator in its first two years. Now in service or on order for operating pressures from 130 to 1325 pounds.

At 130 Pounds Gage:
Holding practically constant boiler water level in spite of severe load fluctuations on a boiler fired by waste heat from an open hearth.

At 400 Pounds Gage:
Water level held within plus or minus 1½ inch on outdoor boiler installation carrying combined utility and sugar mill load, with capacity of 160,000 lbs. per hour.

At 450 Pounds Gage:
Utility perfectly satisfied with results from first installation. Orders two more Flowmatics for new 475-pound pressure boiler plant.

At 850 Pounds Gage:
Water level held within plus or minus 1½ inch on utility boiler carrying loads up to 400,000 pounds per hour. Another plant in same system orders Flowmatic for new boiler of same size and pressure.

Write for Bulletin 409-A

NORTHERN EQUIPMENT CO., 511 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY, AUSTRIA AND ITALY . . . . REPRESENTATIVES EVERYWHERE

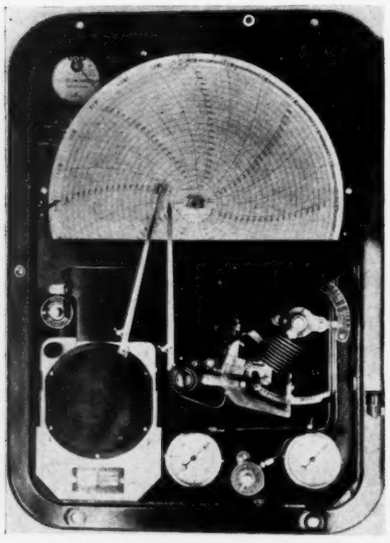
Get closer boiler water level control with the new

COPES

FEEDS BOILER ACCORDING TO STEAM FLOW•AUTOMATICALLY

FLOWMATIC

★ REGULATOR



records true temperature above, below and at control point. Field adjustability has been increased, whereby throttling range and rate of reset may be changed over wide scope through finger adjustments to suit requirements of process involved. Bulletin 507.

The Bristol Co, Waterbury, Conn.

Refractories

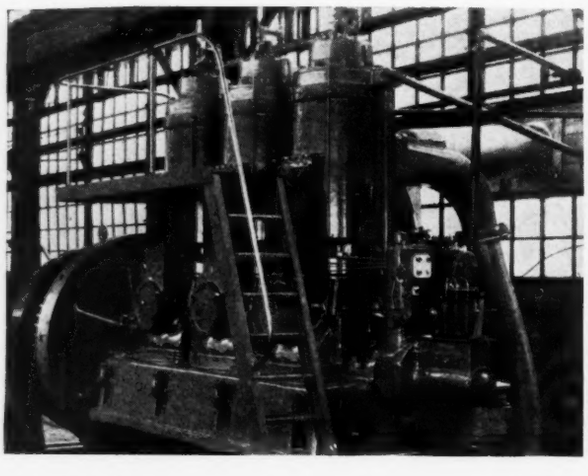
Two products, "Coprtex" block and heat-insulating cement, are designed for high temperatures. Features of block are: low-lineal shrinkage, high insulating efficiency, high modulus of rupture, accommodation of rivet heads and similar projections, and availability in special as well as standard shapes. Cement has much same characteristics.

Armstrong Cork Co, Lancaster, Pa.

Diesel Engine

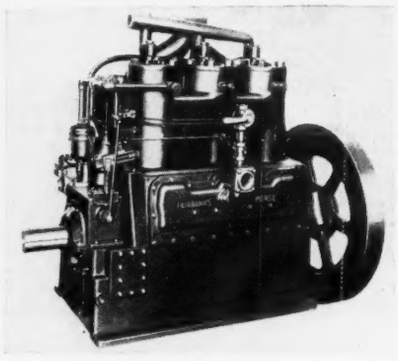
TYPE VC, 2-cycle, solid-injection diesel is built in sizes of 55 to 400 hp. Features include: Bosch fuel-injection pumps and nozzles, injection pump cams driven direct from engine crank shaft, injection cam rollers with needle-type roller bearings, automatic lubrication, and hand speed-control synchronizer. Illustration shows 3-cyl, 165-hp, 13x16 in., 327-rpm engine direct-connected to 110-kw generator on test floor.

Ball-Muncie Engine Co, Muncie, Ind.



Convertible Oil and Gas Engine

MODEL 34-AC-6, designed as heavy-duty pumping engine, is 2-cycle, vertical, 2- or 3-cyl. Speed, ranging from 300 to 850 rpm, is governor controlled. Furnished with either standard or reverse rotation and with power takeoff on either end. Principal parts are interchangeable on oil and gas engines. Bulletin 3400.

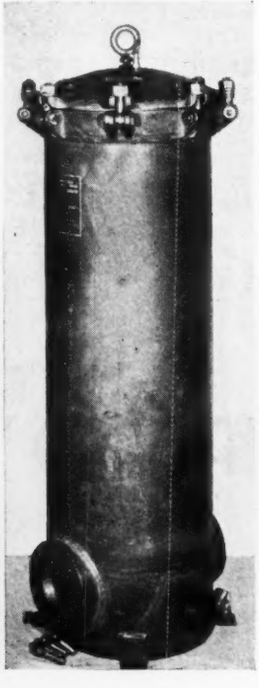


Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.

Oil Filter

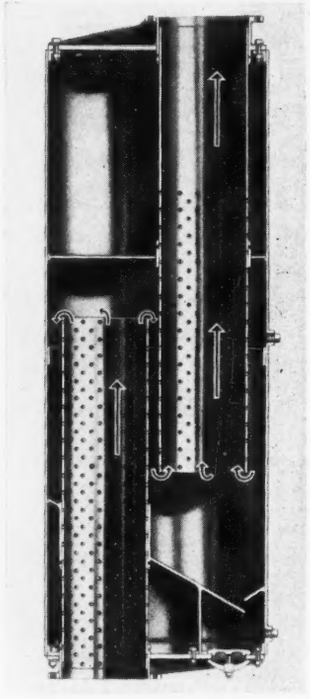
IMPROVED pressure oil filter, similar to Type 4L, has eight closely woven textile filter-bag elements wound around a centrals pool. Liquid filters through bags from inside out. Bags may be thrown away with dirt inside them, or reversed and cleaned. Automatic bypass and relief valve in bag spool will relieve pressure if bags clog. Made in three sizes of 4609, 9472 and 15,496 sq in. filtering surface. Range of operating pressures is 1 to 100 lb. Operating-temperature range from lowest liquid will flow to 200 F.

Wm W Nugent & Co, 410 N Hermitage Ave, Chicago, Ill.



Diesel Muffler

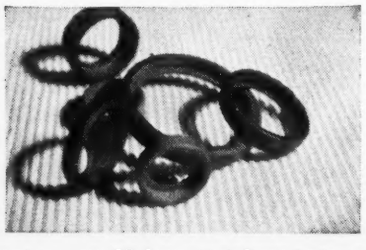
ATP-SERIES spark-arresting muffler removes carbon particles and sparks from exhaust gas. 3-pass construction; exhaust gas enters from below, is diverted downward, then upward, and out. Carbon particles are separated as gas changes direction. Reactance chambers at inlet and outlet ends suppress low-pitched noises while high-pitched noises are dissipated in spark-arresting chamber. Trapped carbon particles can be removed through accessible hand hole at bottom of muffler. If it is desired to reduce exhaust-gas temperature and to make doubly sure that all incandescent particles are extinguished, water-spray nozzle can be introduced into a pipe plug provided for that purpose. Second plug drains water. Bulletin 332.



Burgess Battery Co, Acoustic Div, 111 W Monroe St, Chicago, Ill.

Conduit-Pipe Ends

"DILECTO" pipe ends are used at ends of conduit pipe which ordinarily would be cut off where wire leaves pipe and goes into machine or some piece of equipment, or would have metal protector on the end. These pipe ends, a molded laminated plastic with high electrical insulating properties, have good mechanical strength, are unaffected by water, steam chemicals, etc, and prevent any elec-



(Continued on page 116)

NEVER GETS OUT OF ADJUSTMENT

SLOAN

. . . BECAUSE there's nothing to adjust

● The North Star never requires adjustment. Neither does the Sloan "Royal" Flush Valve. There is no place on either for an adjustment set-screw. ● The Sloan Royal Flush Valve automatically delivers the *exact* requirement of water every time the handle is tripped. Neither accident nor malice can change this constant performance. ● It is this mathematical dependability that puts Sloan so far in the lead it is really conservative to say: "More Sloan Valves are sold than all other makes combined."

SLOAN VALVE COMPANY • CHICAGO

SLOAN *Flush* VALVES

MAKERS ALSO OF THE "STAR" "NAVAL" AND "CROWN" VALVES

Power Lines

Besler Sees Future for High-Pressure Engine

While diesel locomotives have captured more headlines, steam motive power for railways has, in fact, been making spectacular progress. For more than a year a rail car, with a 1400-lb packaged steam plant tucked away in one end, has been operating between Bridgeport and Waterbury, Conn. This unit was developed by Besler Systems, under the leadership of George D Besler and William J Besler.

POWER is not directly concerned with railway motive power, but has been interested in these units as possibly pointing the way to stationary-power applications of high-pressure engines. So the editors asked G D Besler, in a recent interview, to give POWER readers the benefit of his thoughts along this line.

"There is a definite future," said Mr. Besler, "for small high-pressure steam engines in stationary plants. With high

George D Besler

throttle pressure, the piston engine can have reasonably good efficiency, even though it operates against back pressure. This makes it possible to generate a lot of power as a byproduct of a heating or process load.

"Our locomotive experiments prove that pressure as high as 1000 lb is entirely practical. At this pressure, a small backpressure unit is very effiicient. Operating against 10-lb backpressure, a 100-kw unit will consume about 10 lb of steam per hphr, or 15 lb per kwhr. With boiler efficiency well above 80%, you can get a kilowatt hour for about 1.1 or 1.2 lb of fuel oil. I am assuming the use of a once-through boiler like that used in our railroad applications.

"For continuous service," Mr. Besler continued, "cylinder lubrication would limit throttle temperatures to somewhere between 765 F and 780 F maximum. It might be possible to get along without lubrication in certain applications; in that case the temperature could run considerably higher.

"In all of our installations to date we have specialized on double-acting, compound, piston-valve engines. The efficiency of these engines is so high over a wide range of output that I can see no reason to use any other type for the stationary plant. It would probably be cheapest and best to use fixed-cutoff in all cases and based on experience, I would recommend conservative piston speeds, say 600 to 700 fpm, for continuous service."

Asked why so few high-pressure steam engines have been installed in this country for stationary use, Mr. Besler could give no explanation except tradition and custom. Said he, "There is no good reason why pressures of 500 to 1000 lb should not be used, particularly if the forced-circulation type of boiler is employed."

Water-Wheel Power Gains

Total installed capacity of water wheels in water-power plants of 100 hp or more in the U. S. on Jan 1, 1938, was 17,284,379 hp, according to information filed with the Federal Power Commission. This was an increase of 164,769 hp, or 1% over similar data for Jan 1, 1937.

The ten leading states in total installed capacity of water wheels are: (1) California, (2) New York, (3) Washington, (4) Alabama, (5) North Carolina, (6) South Carolina, (7) Maine, (8) Georgia, (9) Michigan, and (10) Pennsylvania.

Air-Conditioning Survey

Just who has air-conditioning equipment, what kind, how many non-users want it, and who can use more than he has now, are some of the matters covered in a study of the air-conditioning industry recently completed by McGraw-Hill Publishing Co. The survey dug into the experience of 557 industrial companies and 264 firms representing a cross-section of the commercial market, then went on to 166 distributors, dealers and contractors, 49 engineers and architects, and 39 public utilities.

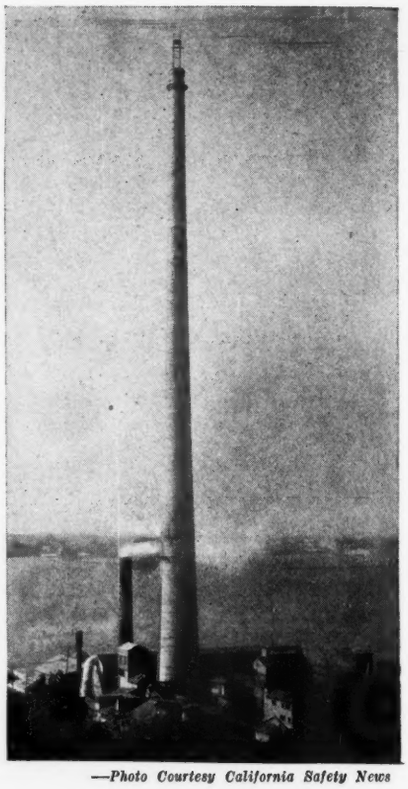
Highlights of the findings show these angles: (1) Replacement of equipment seems more needed in industrial than in commercial establishments, because industrial air-conditioning plants are much older. Industrial units more than five years old account for 48% of the total; in commercial companies, only 39% are more than three years old.

(2) Sixty-four per cent of the industrial firms bought their equipment because of processing needs, while only 36% mentioned comfort as a decisive reason, but commercial buyers went heavily (78%) for the comfort argument.

(3) A prime appeal in the commercial field, determining type of equipment to be purchased, was low cost. In industrial plants, dependability of equipment outweighed all other considerations.

(4) Air conditioning is used in summer only by 52% of commercial buyers, and the year around by 47%. The industrial user keeps his air-conditioning units busy the year round in 78% of cases reported.

(5) Among non-users, 50% of industrial firms surveyed and 72% of the commercial establishments recognized the need for air conditioning, and about a third of each class are planning to buy; the other two-thirds quoted cost as the main reason for not buying air-conditioning equipment at this time.



—*Photo Courtesy California Safety News*

WORLD'S TALLEST STACK

Last year, *Power* published a photograph of 600-ft stack built by Nippon Mining Co at Chinnampu, Korea, calling it the world's tallest. This year's nomination for the title, completed July, 1937, is the 605-ft, 9-in. stack built for American Smelting & Refining Co's Selby Plant near San Francisco by Alphons Custodis Chimney Construction Co, Chicago, Ill.

PERSONALS

DELPHIS VANDAL, formerly with J & R Weir Ltd, has gone into partnership with the firm of Alex McKay Boiler Works, Montreal, Canada.

R B BOALS, who has been light and water commissioner at Fairbury, Neb. since 1929, resigned May 1 to accept a similar position at The Dalles, Ore.

WILLIAM S DAVIS, sales manager of Simplex Wire & Cable Co, Cambridge, Mass., since 1927, and associated with the organization since 1896, has been ap-

This dispenser, and Morton Salt Tablets, represent the most sanitary, economical, and convenient method yet perfected to supply salt to employees. Dirty fingers cannot mark the polished alumilite surface of Morton's dispenser nor can dust or grit collect inside. A special, corrosive-free metal interior keeps tablets snugly dry and a simple push of the lever at the base dispenses tablets, one at a time, without breaking or crumbling. Transparent slot indicates when refill is necessary. Order now — help protect your workers against Heat-Fag.

***HEAT-FAG—that unseen, strength-sapping force that attacks workers and withers production and profits**

Protect your workers — maintain production efficiency and profits! Install Morton Dispensers where all of your employees can conveniently take salt tablets.

Men who sweat *need* salt. The human body, when overheated, cools itself by perspiration. As we perspire, we lose salt and water—and when too much is lost, salt must be replaced or heat-fag results. Otherwise, lack of efficiency and lowered production and profits inevitably follow.

Time and again, this has been established *as a fact* by medical research and practical test in some of the country's leading industries. No wonder, then, that alert, forward-looking executives have insisted that their workers be supplied salt in a convenient, easy-to-take form . . . and that the Morton Dispenser and Morton Salt Tablets are destined to become a fixture throughout American industry. The cost is so small—and the benefits so great, that such is a foregone conclusion.

DISPENSER $4.50

CASE OF 9,000 — 10 GRAIN MORTON TABLETS **$3.15** *Sent Prepaid*

PENNIES INVESTED— DOLLARS RETURNED

Only the purest and most highly refined Salt is used in Morton Salt Tablets.

Write for illustrated bulletin "Heat-Fag" for interesting facts on the value and importance of salt to your workers.

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MORTON SALT COMPANY
CHICAGO, ILLINOIS

pointed vice-president. His former post is occupied by George L Roberts, assistant sales manager since 1927, who is succeeded by George A Grauer, former executive secretary of the wire and cable section under the NRA.

CHARLES D POEY, for 20 years with Consolidated Edison Co of N. Y. and for past few years manager of its Lighting Bureau, recently joined the Greist Mfg Co., New Haven, Conn, in the newly created post of chief engineer of the Illuminating Division.

PERCY S LYON has been elected president of Cochrane Corp, Philadelphia, Pa. Mr. Lyon, who had been assistant to the president of the company since Jan

1, succeeded Eugene Clark, resigned. He was graduated from Cornell University in 1912 and has been associated with Cochrane for 18 years. From 1921 to 1928 Mr. Lyon was chief engineer of the Cochrane company, that year accepting the position of chief engineer of Hall Electric Mfg Co. In 1932, he went with the General Electric Co in commercial engineering work in New York, rejoining Cochrane Corp in 1936.

BUSINESS ITEMS

AMERICAN DISTRICT STEAM CO, North Tonawanda, N. Y., has appointed M J Gibbons Supply Co, 601 E Monument St, as district representative for Dayton, Ohio territory, and Pacific Factors, 703 Market St, for San Francisco, Calif.

BAILEY METER CO, Cleveland, Ohio, announces assignment of following cadet engineers to branch-office duty: Paul Davenport from Penn State College to Philadelphia office at 521 City Centre Bldg; H E Eleniewski from Lafayette College to Buffalo office; O L Garretson from Iowa State College to St. Louis office; H R Kroeger from Ohio State University to Denver, Colo. office at 704 Midland Savings Bank Bldg; F M LeCompte from University of Alabama to New York office, 30 Church St.; H R Keuthy from Case Schol of Applied Science to Chicago office, 20 N Wacker Drive; T O Thompson from University of Missouri to Houston, Tex.; P H Vernor from Purdue University to Milwaukee, Wis.; and J H Dennis from Penn State College to Pittsburgh, Pa.

BLAW-KNOX CO, Pittsburgh, has announced appointment of N B Ornitz as president of its Power Piping Div, and of W N Quartz as vice-president in charge of operations. Mr. Ornitz, a director and vice-president of Blaw-Knox Co, will also continue management of National Alloy Steel Div.

FAIRBANKS, MORSE & CO has moved its general offices to the modernized Fairbanks, Morse Bldg, at 600 S Michigan Ave, Chicago. This is 4 blocks from the building at 900 S Wabash Ave, which was the company's headquarters for a third of its 108 years.

MCCLAVE-BROOKS CO, Scranton, Pa., has appointed Walter Scott Elder as sales engineer for Chicago, 431 S Dearborn St. Also, this company has named Vantuyl Co, 16701 Kinsman Rd, Cleveland, Ohio, as representative for northern Ohio.

MODINE MFG CO, Racine, Wis., has appointed the following new representatives: Paul R Winston Co, Dallas, Tex.; Disney-Liffel Co, Inc, Kansas City, Mo.; and Ace Combusion Co, Shreveport, La.

MURRAY IRON WORKS, Burlington, Iowa, has appointed L R Merritt & Co, 250 Park Ave, New York, N. Y., as district sales managers for turbines, engines and turbine-driven unit heaters.

MORSE CHAIN CO, Ithaca, N. Y., announces following changes in its sales organization: Arthur F Weston, formerly Cincinnati office manager, is now Chicago office manager; W C Gilber, formerly in Detroit, has been transfered to Chicago; C A Setter, formerly Cleveland office manager, is now Cincinnati manager; and Lon Sloan, formerly special-development engineer at Chicago, is Cleveland manager.

EAGLE PICHER SALES CO, Cincinnati, announces following distributors for Eagle-Picher industrial-insulating materials: Automatic Coal Burner Co, Beckley, W. Va.; Bemis Refractories Service Co, Springfield, Mass.; Corbett-Wallace Corp, Houston, Tex.; Joseph A Coy Co, Tulsa, Okla.; G M Hardware Co, Beaumont, Tex.; H R Kelly Co, Inc, Brooklyn, N. Y.; Fred H McGee, Chattanooga, Tenn.; McLean-Peterson Co, Cincinnati; United Brick & Tile Co, Oklahoma City, Okla.; and United Engrg & Equipt Co, Nashville, Tenn.

MANNING, MAXWELL & MOORE, Inc, Bridgeport, Conn., has assigned nine new field salesmen to territories. New territories have been created and salesmen with headquarters to serve them are: Charlotte, N. C., Paul Hayden; Jacksonville, Fla., W H Kissam; New Orleans, La., R F Heath; Minneapolis, Minn., K W Johansson; and Columbus, Ohio, W. S. Adams. In addition, existing offices are being strengthened by these men: New York, N. Y., V W Farris; Philadelphia, H H Jones; Chicago, H B Stallings; and Tulsa, Okla., C W Velie. Two new district sales managers are also announced as part of this sales-force expansion. R W Neel is now in charge of newly created southeastern district with headquarters in Atlanta. Malcolm Black has been made manager of southwestern district with headquarters in Tulsa.

NATIONAL ALUMINATE CORP, Chicago, has appointed W O Widener representative in the southeastern states, which include Virginia, Florida, most of North Carolina, South Carolina and Georgia.

SOUTH BEND AIR PRODUCTS, Inc, South Bend, Ind., was recently organized to purchase and continue the ventilating-equipment business formerly conducted by Industrial Fan Div, Bendix Products Corp. President and general manager of the new company is Marshall A Smith, Jr, formerly in charge of sales and engineering of the Industrial Fan Div.

MECHANICAL GOODS DEPT of Goodyear Tire & Rubber Co, Akron, Ohio, has created a new Cleveland district for sale and distribution of mechanical rubber goods, with headquarters in the company's tire-sales district office in Cleveland. Manager will be H D Foster, who has been Cleveland territory mechanical goods salesman for Goodyear since 1924.

WHEELCO INSTRUMENTS CO, Chicago, has appointed three new representatives to handle sales and service of Wheelco instruments: C I Gillen, 5026 Osage Ave, Philadelphia, Pa.; H F Rehling, 993 South St, Boston; and R W Coward, 2400 Arlington Ave South, Birmingham, Ala.

PIONEER ENGRG & MFG CO, Detroit, Mich, manufacturers of coolant and lubricant pumps, has appointed Willis J Stutson Co, 184 N Wacker Drive, Chicago, as representative in Chicago and northern Illinois.

THE MARLEY COMPANY recently moved into new quarters in the Fairfax industrial district of Kansas City, Kan. The new building, which will serve both as warehouse and offices, is equipped with an automatic sprinkler system and a modern heating and ventilating plant, including 32 tons of air conditioning for the offices. A large storage yard and a railroad siding will permit loading three cars at once.

Meetings

American Institute of Electrical Engineers —*Summer Convention, June 20–24, Washington, D. C. H H Henline, secretary, 33 W 39 St, New York, N. Y.*

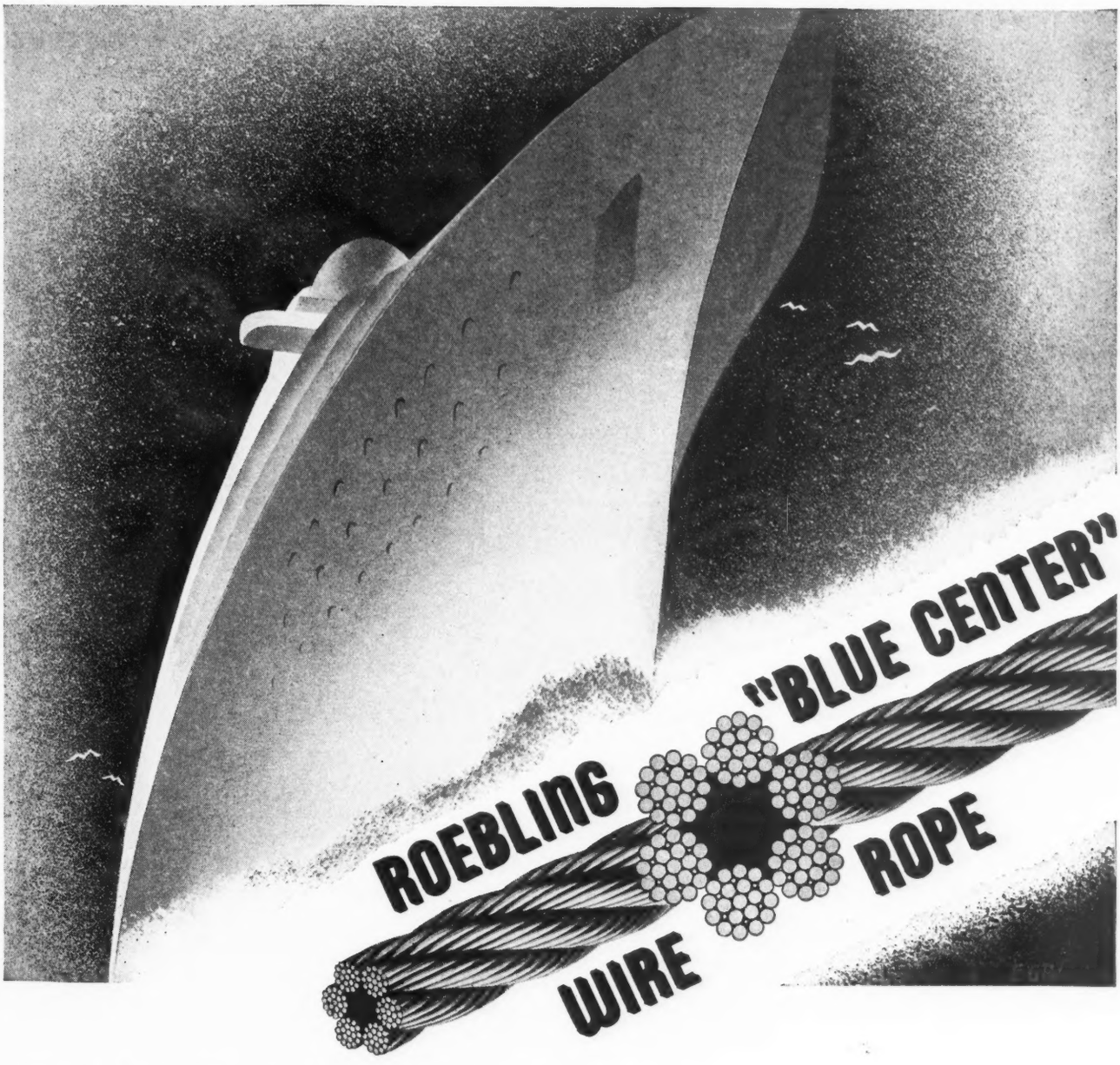
American Society of Mechanical Engineers —*Semi-Annual Meeting, June 20–24, St. Louis, Mo. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

Edison Electrical Institute—*Annual Meeting, June 7–9, Atlantic City Auditorium, Atlantic City, N. J. M B Woods, secretary, 420 Lexington Ave, New York, N. Y.*

National District Heating Assn—*Annual convention, June 28–July 1, Lord Baltimore Hotel, Baltimore, Md. W H Sanford, secretary-treasurer, 1317 Spruce St, Philadelphia, Pa.*

Smoke Prevention Assn—*32nd Annual Convention, May 17–20, Andrew Jackson Hotel, Nashville, Tenn. Frank A Chambers, secretary-treasurer, 139 N Clark St, Chicago, Ill.*

SETTING NEW STANDARDS!



Roebling Rope brought to its highest stage of development! Setting new standards of service economy . . . new standards of safety!

JOHN A. ROEBLING'S SONS CO., TRENTON, N. J.
BRANCHES IN PRINCIPAL CITIES

STRONGER—Wire of highest strength consistent with ductility and toughness

TOUGHER—Provides maximum resistance against wear, sudden shocks, vibration

SAFER—Unequalled for uniformity of quality

SAVING—Insures lowest general average operating cost

THE HIGHEST DEVELOPMENT IN ROEBLING WIRE ROPE

One-Sided . . .

THREE or four weeks ago, my youngest came in about three hours after he'd been told to. I sent him to bed without his supper. But his mother objected. "George," she said, "don't you think you're being a little highhanded? You didn't even give him a chance to say 'Hello'!"

So I went upstairs. Tommy was in bed, sniffling a little, and turned his back to me when I walked in. "Listen, Kid," I began, "I want to talk this over with you."

In spite of the bed covers, his muffled reply was to the point: "There's no use trying to talk to you! You're always bossing me around. Just because I came in a little late, you sent me to bed. You were mad, and decided I was wrong before I ever got home. You had your mind all made up!"

After some more sniffling, I finally got him to go on—that "mind all made up" remark sort of hurt my conscience a little. Still with his back to me, he said, "Well, why didn't you give me a chance to say something? Why didn't you let me explain? You decided I was wrong without waiting to hear my side of the story. If you woulda waited, you'd at least have had both sides to decide on."

I'm ashamed to admit that a kid had to tell me that! After all these years, I should have learned that almost always the other fellow has a sound reason for what he thinks and does—if you give him a chance to explain. That kid taught me an old lesson all over again—don't make up your mind one way before you hear both sides of the story. Even a mirror isn't one-sided.

Things as well as people have two sides—there's always more than one way to do a job, and at times somebody else's way is better. Right there is the big advantage of talking to another person about your problems, or in reading what others have to say. Just for that reason, I get a real kick out of *Power's* "Readers' Problems"—sometimes it shows six or eight ways to fix one of my own troubles. With other opinions alongside my own, I can make a lot more sensible choice.

George Edwards

Engineer

NO CORROSION FROM CRUDES

● *Byron Jackson oil pump installation for 5000-barrel-per-day cracking unit in the Mid-Continent oil fields. Inner case is made of Nickel cast iron.*

Made of Nickel cast iron, it shows no signs of erosion, or other deterioration, after nine months' severe service

● Gulf Coast crude with specific gravity of .76, temperature of 750° F. is discharged at a pressure of 1100 p.s.i. by the pump shown above. Driven by a 600 H.P. Terry condensing turbine, it operated smoothly and continuously for nine months. No opportunity to examine the Nickel cast iron inner case arose, until the pump was stopped for minor repairs to an oil line.

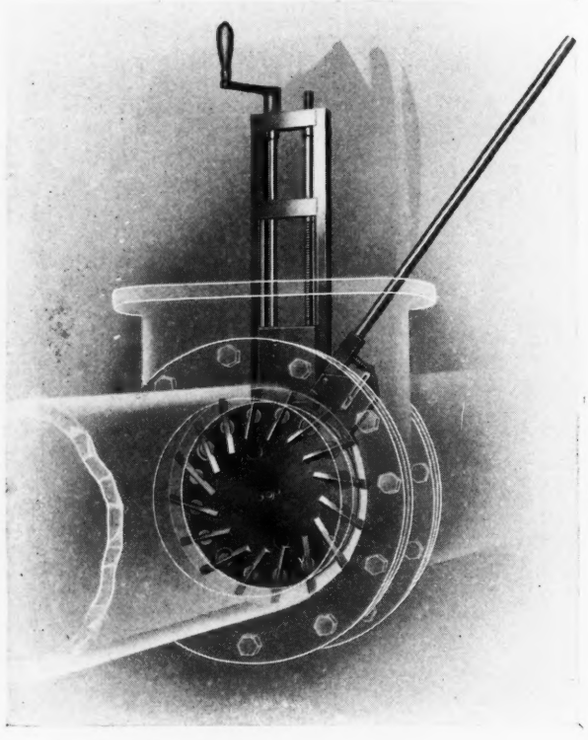
Quoting the manufacturer, Byron Jackson Co., Los Angeles, "The entire output of the plant has been handled by this pump, and undoubtedly a great deal of coke and sediment has passed through this unit, yet the Nickel cast iron inner case shows no noticeable effects of either corrosion or erosion."

CAST NICKEL IRON

Nickel cast iron for refinery applications affords a combination of extreme hardness and toughness plus resistance to corrosion. Consultation on problems involving the use of this Nickel alloy is invited.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

Reseat that valve in place!



At the first sign of leakage

use a **DEXTER**

Seats and gates are refaced, quickly and easily—exactly alike—making a perfectly tight fit—and stopping leakage *at once.*

That means stopping waste of steam and water—saving time and labor—and possibly the cost of new valves.

Machine is simple. Results perfect, made for valves small as $1\frac{1}{2}$"—large as 42".

Write for Catalog 24 describing this and also our machines for reseating globe valves and pump valves.

Also Manufacturers of the Swendeman Automatic Separator which eliminates Water and Oil from Compressed Air.

THE LEAVITT MACHINE CO.

10 East River St. Orange, Mass.

New Equipment

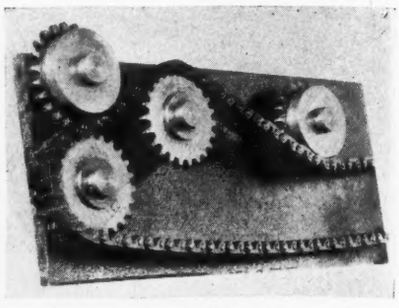
(*Continued from page* 108)

tricity (which may have leaked into conduit) from grounding and causing sparks.

Continental-Diamond Fibre Co., Newark, Del.

Chain Drive

DUPLEX chain resembles in appearance two narrow side-guide chains constructed so that links of each are pointing in opposite directions in order to drive sprockets from each side. Narrow-faced

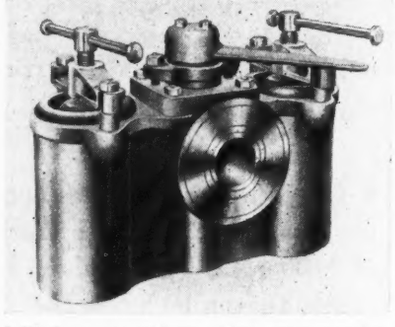


sprockets are used, engaging only one half the chain, with their hubs supporting the other half not in engagement. For operating groups of rolls or other installations where sprockets must be close together.

Ramsey Chain Co, Inc, Albany, N. Y.

Oil Strainer

"DUOFLO" suction oil strainer, made of semi-steel, has two perforated baskets held in place by covers, which allows one strainer to be cleaned while other is operating. Made in 5 sizes: $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3 and 4 in. All suction flanges are



drilled to American Standard specifications. Each assembly is tested to 150 lb per sq in. before shipment. For industrial oil-burning furnaces, oil-processing lines, etc.

Sheffler-Gross Co, Inc, 5th and Chestnut Sts, Philadelphia, Pa.

Desuperheater

DESIGNED to solve problem of giving satisfactory results at light loads by introducing steam jet to atomize cooling water so that mist is introduced into steam pipe. Both cooling water and steam are

Attention! POWER ENGINEERS

- small plant
- like hundreds
- of others
- wasting
- h.p. dollars
- discarded
- old steam engine
- installed
- **BUCKEYE**
- **DIESEL**
- now saving
- $350 per month
- $4200 per year
- in power costs
- no plant owner
- would refuse
- corresponding
- savings
- HOW 'BOUT
- **YOU?**

Yes, gentlemen, this is only one of hundreds of steam plants that have discarded time-worn, money-wasting steam units for the "almost unbelievable" savings of Buckeye Diesels.

The Plant shown here is the KUENZEL WOOLEN MILLS, New Bremen, Ohio. Mr. Gilberg, the Manager, not only gave out these savings but adds: "The Buckeye Diesel is the best investment we ever made."

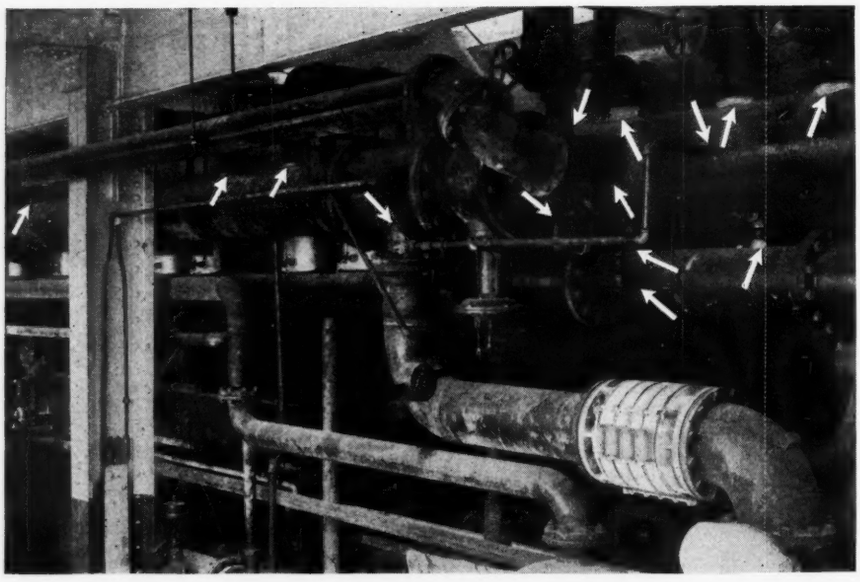
If you operate a plant with a steam engine or purchased power, you may be able to make substantial savings by installing a Buckeye Diesel. A Buckeye Engineer will be glad to look over your plant and submit facts and figures. No cost or obligation. Write today.

BUCKEYE DIESEL ENGINES

THE BUCKEYE MACHINE COMPANY

LIMA, OHIO

Building Power Plants Since 1908



Complex Piping Installations Simplified With

BONNEY WELDOLETS·THREDOLETS

THE bigger the piping job, the greater the number of branch pipe take-offs —the bigger your savings will be when Bonney WeldOlets and ThredOlets are used.

WeldOlets and ThredOlets are the only welding outlets that eliminate all cutting, threading and fitting of the main pipe. WeldOlets and ThredOlets are the only welding outlets that make branch pipe connections of full pipe strength.

In addition, their funnel-shaped outlets improve free flow conditions and reduce turbulence and friction to a minimum.

Because of these features and the savings which WeldOlets and ThredOlets make possible, engineers, contractors and other responsible for efficient piping installations have standardized on them when making branch pipe take-offs either for maintenance or new construction.

Improve your next piping job and save with these fittings. Once used, you'll standardize on them.

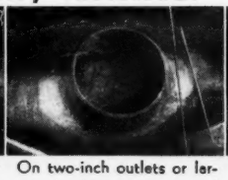
For full information write for Bulletin WT23 or see your nearest distributor.

The names "WeldOlets" and "ThredOlets" are Bonney trade marks registered in the United States Patent Office. Full patent coverage for designs, principles and construction has been granted in the United States and foreign countries.

They are easily installed!

WeldOlets and ThredOlets are quickly and easily installed. Select the position of the outlet anywhere on the main pipe, mark center lines and tack the fitting into position.

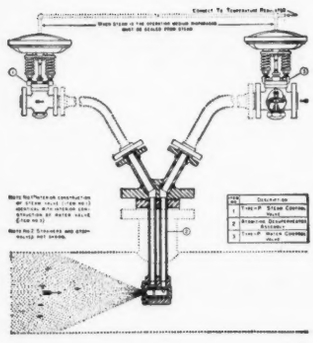
Then weld by electric-arc or oxy-acetylene method. A leak-proof joint of full pipe strength is obtained.



On two-inch outlets or larger the button is removed after installation. A full inspection of the inside of the joint is possible when WeldOlets and ThredOlets are used.

A simple Vee weld is used for attaching the branch when WeldOlets are used. If ThredOlets are used, the branch is screwed into position.

BONNEY FORGE & TOOL WORKS, Allentown, Pa.
WELDOLETS·THREDOLETS
. . . *Welded Outlets for Piping* . . .
Stocked by Leading Distributors

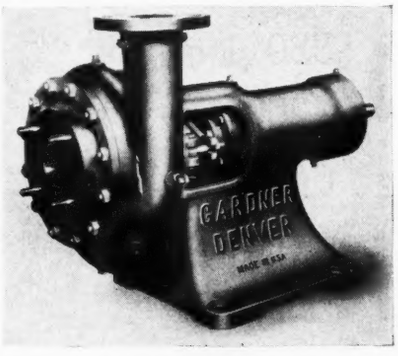


controlled by two single-seat, parabolic-disk valves, in turn controlled by temperature pilot. As temperature increases, pilot releases pressure from control-valve diaphragms, allowing them to gradually open, supplying correct mixture of water and steam. To use this unit, it is necessary to reduce before desuperheating, or supply steam for atomizing purposes, at a higher pressure than that in main pipe. If this cannot be supplied, a mechanical-atomizing nozzle must be used.

Spence Engineering Co, Inc, Walden, N. Y.

Centrifugal Pumps

NON-CLOGGING Types J and K centrifugal pumps designed for handling industrial wastes, process fluids, food products and raw unscreened sewage. Impeller, of hard close-grained alloyed cast iron with two streamlined blades, is rounded to prevent catching stringy or fibrous material and



proportioned to permit passage of the size solids, indicated for each size pump, without clogging. High-tensile-strength alloyed-cast-iron casing; separate casting stuffing box bolted directly to casing; water-seal ring with tapped opening for connection to clear water when handling abrasive materials. Built for both horizontal and vertical drypit installations.

Gardner-Denver Co, Quincy, Ill.

Constant-Current Regulators

STATION-TYPE constant current regulators made in two models. Type RS, non automatic, is designed to operate in an indoor substation with manually operated control panel. It will regulate from full load to no load within 1%, plus or minus, of rated secondary current when operated at rated primary voltage and frequency and on unity power factor load. Type RZ fully automatic regulator

A GUARANTEE
WRITTEN IN STEEL

goes with

CHAPMAN
POWER PLANT VALVES

Not in words, nor on paper, but rather a pledge that's poured in steel, backs a Chapman Valve's performance.

From raw materials — selected and checked with utmost care — special steels are made and poured *in our own foundries* — right where Chapman's expert metallurgists can carefully watch each melt. Then castings are machined to decimals of precision by men with years of experience. And finally each finished valve is thoroughly tested for what it can do for you.

All Chapman Power Plant Valves go through this rugged routine — the gate, globe, check and angle valves—the valves of all steels and every type of operating mechanism—the valves that take pressures to 1500 lbs. and 1000° F temperatures. Write for full information.

High Pressure Steam Valve with Welding Ends, Equipped with Chapman Motor Units

CHAPMAN STEEL VALVES ARE MADE IN THESE ALLOYS

- Carbon Steel.
- Carbon Molybdenum Steel.
- Chrome Nickel Steel.
- Nickel Steel.
- Chrome Molybdenum Steel.
- Chrome Tungsten Steel.
- Chrome Nickel Tungsten Steel.

The **CHAPMAN VALVE**
MANUFACTURING COMPANY
INDIAN ORCHARD, MASSACHUSETTS

Smooth PERFORMERS!

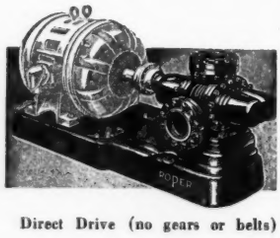
To be smooth performers, those who teeter-totter must have absolute balance and perfect co-ordination.

To be smooth performers, pumps must likewise have absolute balance and perfect coordination. Roper Pumps have these qualities . . . they *are* smooth performers . . . smooth because they are precision built and because 80 years of pump building experience is incorporated in every pump that leaves the Roper plant. If you stick to ROPERS for your pumping requirements, you'll be holding costs to an absolute minimum.

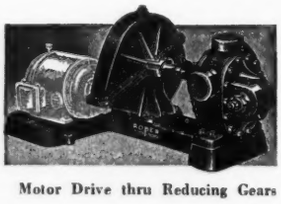
Roper Rotary Pumps with only two moving parts are the acme of simplicity . . . a good reason for their record of extra long service.

Write for Bulletin "P" and prices

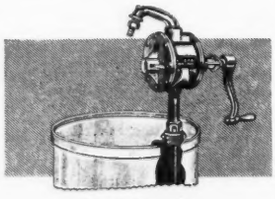
GEO. D. ROPER CORPORATION
ROCKFORD, ILLINOIS



Direct Drive (no gears or belts)

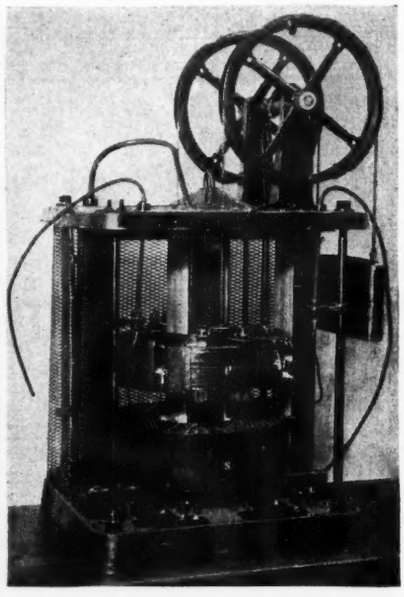


Motor Drive thru Reducing Gears



Hand Transfer

ROPER Rotary PUMPS
DEPENDABLE - SINCE 1857

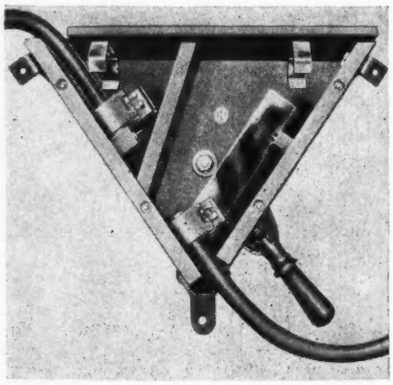


designed primarily for unattended substation, but can be used indoors.

Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.

Safety Feeder Switch

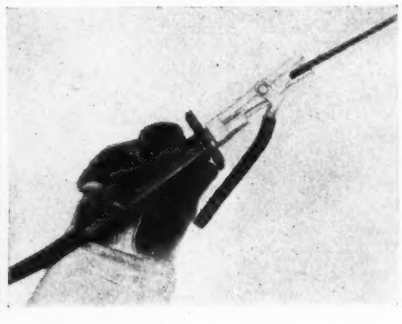
LOW-CAPACITY feeder safety switch is of quick-make, quick-break type, for 250-600 volts in 300- and 400-amp sizes. Enclosed in fireproof case. Heavy rubber handle gives further protection. Action of connecting or disconnecting switch is instantaneous and quick make insures positive contact when switch is closed.



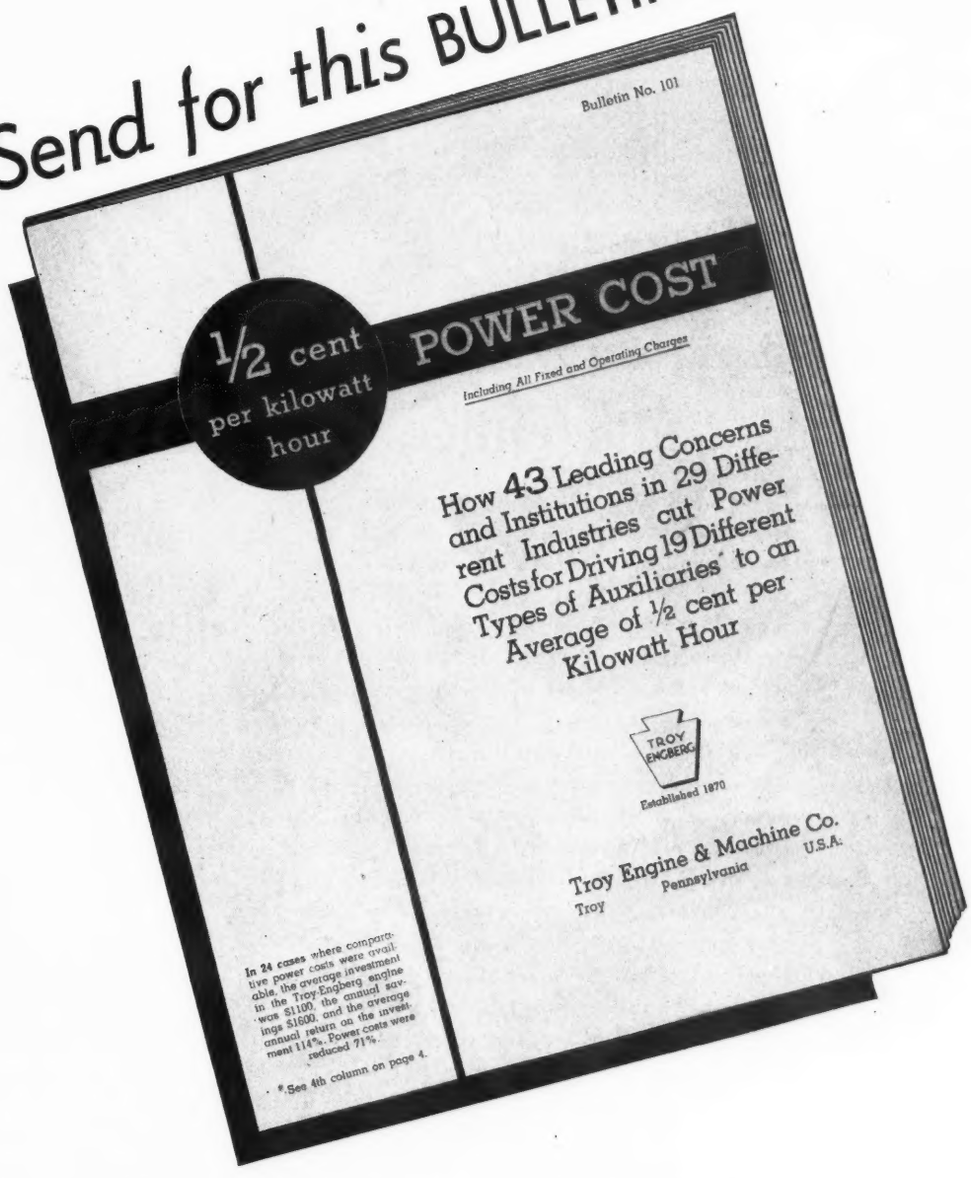
Ohio Brass Co, Mansfield, Ohio.

Electrode Holder

"TWECO" electrode holder, light weight and cool running, has insulated spring



Don't Send for this BULLETIN . . .


Bulletin No. 101
½ cent per kilowatt hour
POWER COST
Including All Fixed and Operating Charges
How 43 Leading Concerns and Institutions in 29 Different Industries cut Power Costs for Driving 19 Different Types of Auxiliaries to an Average of ½ cent per Kilowatt Hour
TROY ENGBERG
Established 1870
Troy Engine & Machine Co.
Troy Pennsylvania U.S.A.
In 24 cases where comparative power costs were available the average investment in the Troy Engberg engine was $1100, the annual savings $1600, and the average annual return on the average investment 114%. Power costs were reduced 71%.
*See 4th column on page 4.

. . . If Your Power Costs You Less Than 1c per KWH

You might be interested casually in knowing how many leading up-to-date concerns and institutions are driving auxiliary equipment such as compressors, fans, blowers, dryers, stokers, pumps, generators, cookers, etc. for an average cost at the drive shaft of ½ cent per kwh. You might be interested in finding out how this might be done in any plant using steam for processing or heating. BUT . . . if you are paying more than 1¢ per kwh for power you should be interested for the sake of your own cost structure. The coupon below will bring you an interesting story.

Write Today!

TROY ENGINE & MACHINE CO., 1439 Railroad Ave., Troy, Pa.

Gentlemen: Please send us a copy of Bulletin 101 which describes in detail the results of the surveys referred to above.

Individual and Title .....

Company .....

Address .....

DARLING, PLEASE HURRY HOME, I'M ALL READY TO GO TO THE PARTY
SORRY HONEY, I'LL HAVE TO WORK AGAIN TONIGHT TO REPAIR LEAKY VALVES

Don't Work While Others Play

Are you content to continue the drudgery of working nights and holidays to repair leaky valves, while others are out enjoying themselves? If not, you can rid yourself of over-time work just as thousands of others have done—by using quick-and-easy-to-repair Fairbanks Renewable Valves.

Then, too, you won't have to do the back-breaking work of removing pipe coverings and taking out a length or more of pipe in order to get leaky valves out of the line and install new ones. In a few minutes you can replace worn seats or wedges without removing valves from the line.

Then, too, you won't have complaints from the front office that you are spending too much for new valves. For new parts for the "Fairbanks" cost only a few cents.

Try a few Fairbanks "Renewables." You'll regret you didn't use them long ago.

Distributors everywhere sell Fairbanks Bronze and Iron Valves in types and sizes to meet practically every requirement.

Write for Catalog 21.

THE FAIRBANKS COMPANY

Valves, Dart Unions, Hand Trucks and Wheelbarrows

397 Lafayette St., New York, N. Y.

Boston • Pittsburgh • Distributors in Principal Cities
***Factories:* Binghamton, N. Y. • Rome, Ga.**

Fairbanks Renewable Valves

tensioning member that is inclosed and out of the way. Spring tension is adjustable to suit strength of operator or size of electrode. Holder jaws have electrode lock from which the rod cannot fall out of position. Handle grip, guard and trigger are shockproof. Replaceable copper-jaw tips.

Armstrong Mfg Co, Bridgeport, Conn.

Improved Wrenches

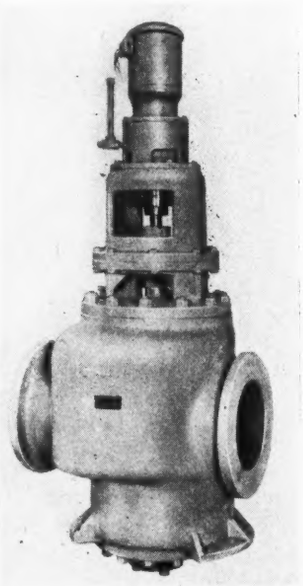
COMPLETE line of carbon-steel wrenches made in 50 patterns and more than 1000 sizes. Dorp-forged from improved

quality carbon steel. Other advantages claimed are: better hand grip and greater and safer bearing on nut.

J H Williams & Co, 75 Spring St, New York, N. Y.

Self-Cleaning Strainer

FOR removing relatively large quantity of fine dirt, sand, etc, from water which has already passed through a traveling screen or conventional twin or single strainer, Type K self-cleaning strainer is automatically cleaned by continuous back flushing of strainer element. Straining



cartridges are made of alternate layers of flat and corrugated copper strips. Rotating element is a shaft on which is mounted rubber-faced sealing box or boxes. Through these, back-flushing water and dirt flow to drain at bottom of strainer body. Motor and speed reducer are integral unit on strainer cover. Made in sizes from 4 to 24 in. for pressures from 25 to 125 lb g.

Elliott Co, Jeannette, Pa.

Portable Potentiometer

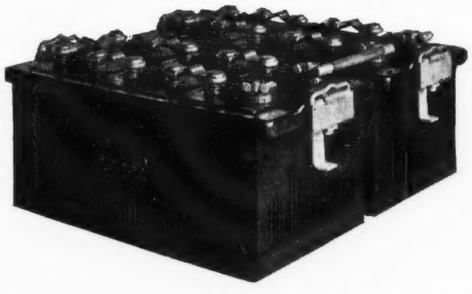
FIELD and laboratory service potentiometer is built in three models; No. 310,

Exide offers a line of special types for starting Diesel engines

SPECIAL DIESEL TYPES

FOR DIESEL STARTING SYSTEMS WITH VOLTAGES HIGHER THAN 12 VOLTS, USE 6 OR 12 VOLT BATTERIES IN SERIES WITH CABLE JUMPERS

TYPE	Cat. No.	Price Each	Plates Per Cell	Volts	Capacity Ratings in Amperes				Separator	Over-all Dimensions in Inches			Net Weight in Lbs.	Code Word
					3 Min. 0° F.	3 Min. 32° F.	1½ Min. 0° F.	1½ Min. 32° F.		L	W	H		
XH-13	22957	See Your Exide Wholesaler	13	6	303	392	402	510	First Grade Port Orford Cedar	9 1/16	7 1/16	9 5/16	48	Ahead
XH-15	22958		15	6	354	457	469	595		10 1/4	7 1/16	9 5/16	54	Aimed
XH-17	22959		17	6	404	522	536	680		11 1/2	7 1/8	9 5/16	61	Aisle
XH-19	22960		19	6	455	588	603	765		12 5/8	7 1/8	9 5/16	67	Alarm
XH-21	22961		21	6	505	653	670	850		13 11/16	7 1/8	9 5/16	73	Alate
XH-25	22411		25	6	606	784	804	1020		16 3/16	7 1/32	9 1/2	85	Alban
6-XCK-21-3R	22600		21	12	450	595	620	780		21 3/8	9 13/16	10 3/16	145	Armed
6-XCK-25-3R	22601		25	12	540	714	744	936		21 5/32	11	10 3/16	168	Aroma
3-DS-27-1R	26530		27	6	692	878	910	1183		16 5/16	7 1/8	10 7/16	90	Alien
3-DS-41-1R	26531		41	6	1064	1350	1400	1820		25 1/2	7 1/2	10 1/4	148	Alike
3-DL-33-1R	26532		33	6	848	1072	1096	1456	Mipor	25 1/2	7 1/2	10 1/4	156	Elbow



MEETING the requirements of Diesel engines, and specifically designed for various individual needs, Exide offers a line of special batteries for service in this field. They all provide ample voltage necessary for high cranking speed at low temperatures. Yet there has been no sacrifice of the dependability and long service for which Exides are known in every field.

The Exide line takes care of all high-speed Diesel engines. Exide also has batteries designed for the needs of heavier equipment—in fact, there is no job too big for an Exide. If you are operating the heavier type of Diesel-powered equipment, write for details. And in any case, send for the authoritative booklet below.

FREE BOOKLET ON STARTING DIESEL ENGINES

Gives information that every operator of Diesel-powered equipment should know. Interesting, informative, semi-technical, and well illustrated. This book gives the facts. Write today for "Electric Starting of Diesels." It is free.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia

The World's Largest Manufacturers of Storage Batteries for Every Purpose

Exide Batteries of Canada, Limited, Toronto

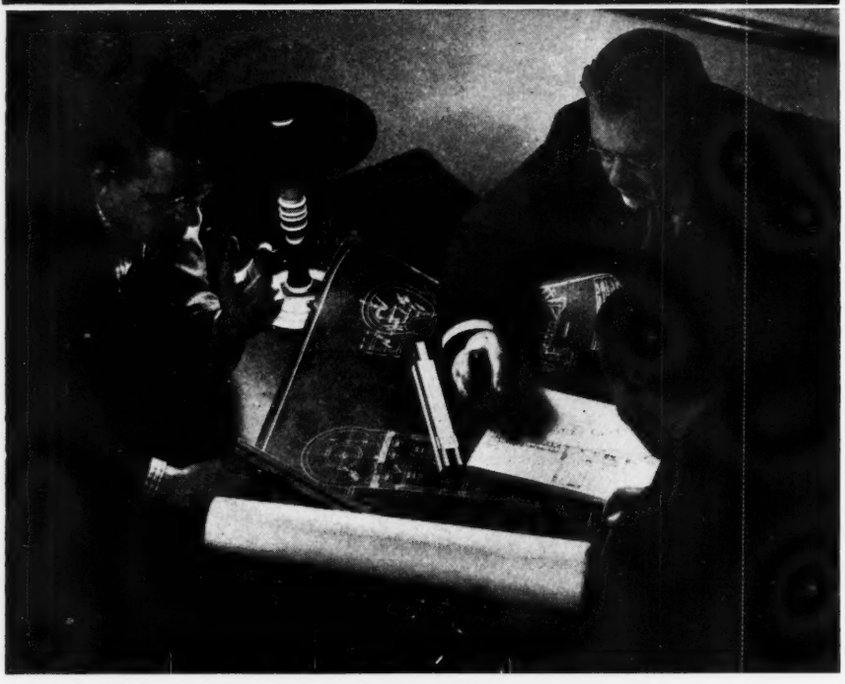
Exide

BATTERIES

FOR STARTING DIESEL ENGINES

SCAIFE

Water Softeners and Water Filters



THE SURVEY IS IMPORTANT

The survey gathers the facts about the mineral character of the raw water, the purpose for which the treated water is intended, the conditions surrounding the water supply, the method of distribution and the other facts pertinent to the problem. The assembly of these facts permits proper selection of the water treating process, whether Hot or Cold, Continuous or Intermittant, Lime-Soda or Base Exchange, to accomplish results.

Take time to have your problem analyzed—study the facts—select a responsible, trained organization to gather these facts and quote upon your needs. It will pay—off the shelf equipment rarely is satisfactory.

We suggest a Scaife Sales Engineer

We pledge ourselves to a careful study of your problem—to build the equipment in accordance with the facts available—to give you performance.

SCAIFE PRODUCTS

Hot Process Lime-Soda Water Softeners . . . Cold Process Lime-Soda Water Softeners . . . Lime-Zeolite Water Softeners . . . Zeolite (Base Exchange) Water Softeners . . . Acid-Zeolite Water Softeners . . . Chemical Feeders (Proportional and Constant) . . . Gravity and Pressure Water Filters . . . Oil Removal Water Filters . . . Swimming Pool Recirculating Systems . . . Boiler Blow Down Systems . . . Household Water Filters and Softeners.

WM. B. SCAIFE & SONS CO.

OAKMONT (Pittsburgh District) PENNSYLVANIA

REPRESENTATIVES IN PRINCIPAL CITIES

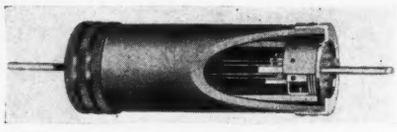
with cold-junction compensator; No. 320 with cold-junction compensator and run-up box; and No. 330 with these two elements plus standard thermocouple line-

compensating rheostat. Standardized with regulation cell, precision slide wires and multipliers. Dual taunt-suspension galvanometer, complete with lock and zero adjuster.

Wheelco Instruments Co, 1933 S Halsted St, Chicago, Ill.

Renewable Fuse

BOTH ends of fuse case have series of small holes through which air circulates. As an additional safeguard to prevent flames escaping in case of a



blow, both fuse ends have series of fine-mesh screens through which air must pass. There are only two parts and the link, making for quick renewal when fuse blows.

Pierce Renewable Fuses, Inc, Buffalo, N. Y.

Readers' Problems

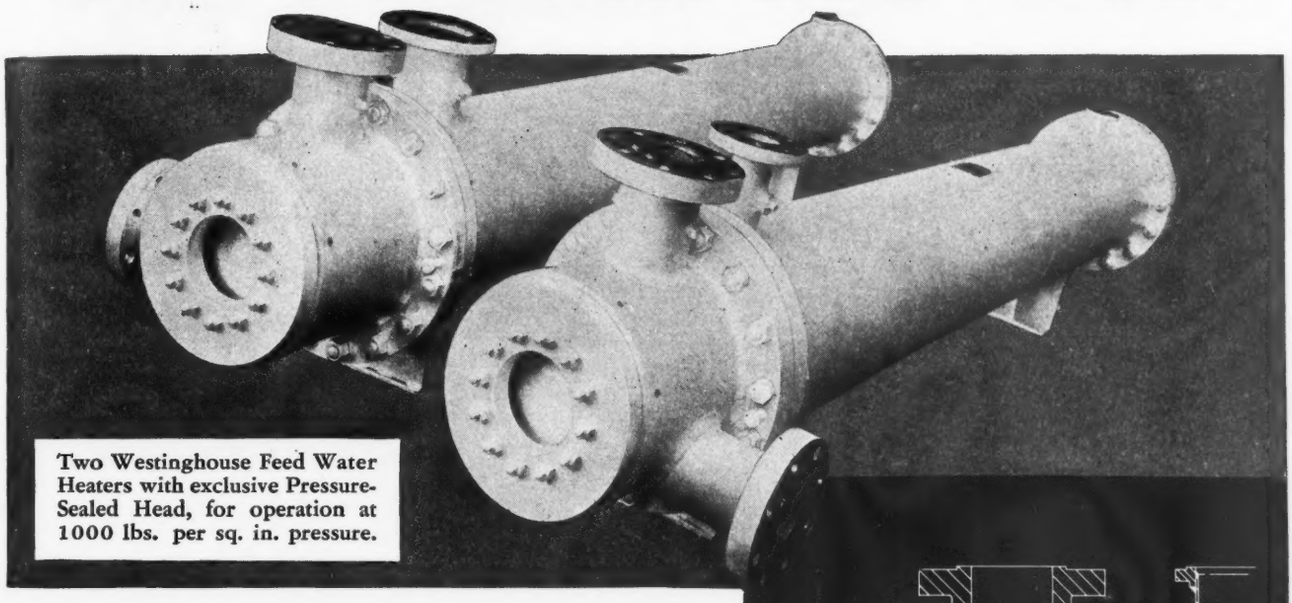
(*Continued from page* 104)

ple set of controls, even if they require some manual attention, that would keep us within the comfort zone without spending a lot of money and acquiring a complicated job too? I would like to know if any POWER readers have had *similar experience.—FMA*

Small Compressors, Manual Control

THREE YEARS age we installed air conditioning in a cafeteria, which had a dining room on street level seating 70 persons and open 24 hrs a day, and a basement dining room seating 360 and open 4 hrs at midday. Five Freon compressors, total capacity 45 tons, were installed; a 7.5-hp and a 10-hp unit for the first floor, and a 10-hp and two 15-hp units for the basement. About 25%

The Higher the Pressure
THE TIGHTER THE SEAL!

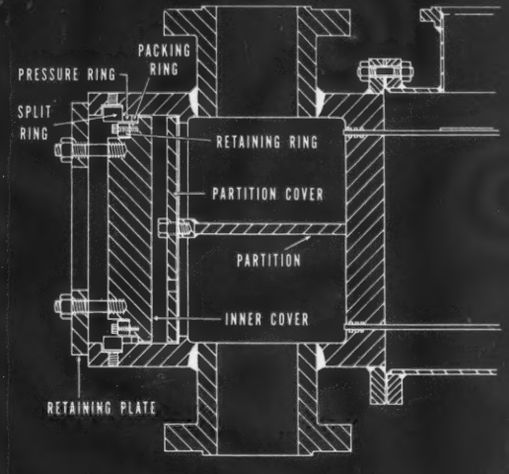


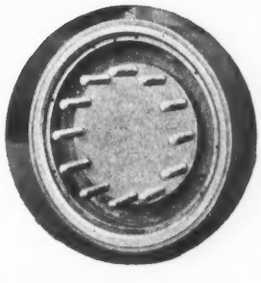
Two Westinghouse Feed Water Heaters with exclusive Pressure-Sealed Head, for operation at 1000 lbs. per sq. in. pressure.

WESTINGHOUSE
Internal Pressure-Seal SOLVES
HIGH-PRESSURE FEED-HEATING PROBLEMS

Today's high boiler pressures present no problems where plant heat balance is maintained with Westinghouse Feed Water Heaters. The exclusive Westinghouse Pressure-Sealed head does not depend on tension in bolts to prevent leakage. The forged steel cover plate is held in place by internal pressure — and the higher the pressure rises the tighter the seal becomes. Inspection is simplified . . . construction is strengthened . . . leakage is eliminated.

Pressure-Sealed heads, for pressures over 450 lbs. per square inch, are one of the many reasons why power plant operators look to Westinghouse for the solution to plant heat balance problems. Call your representative or write for full information. Westinghouse Electric & Manufacturing Company, Dept. 7-N, East Pittsburgh, Pennsylvania.





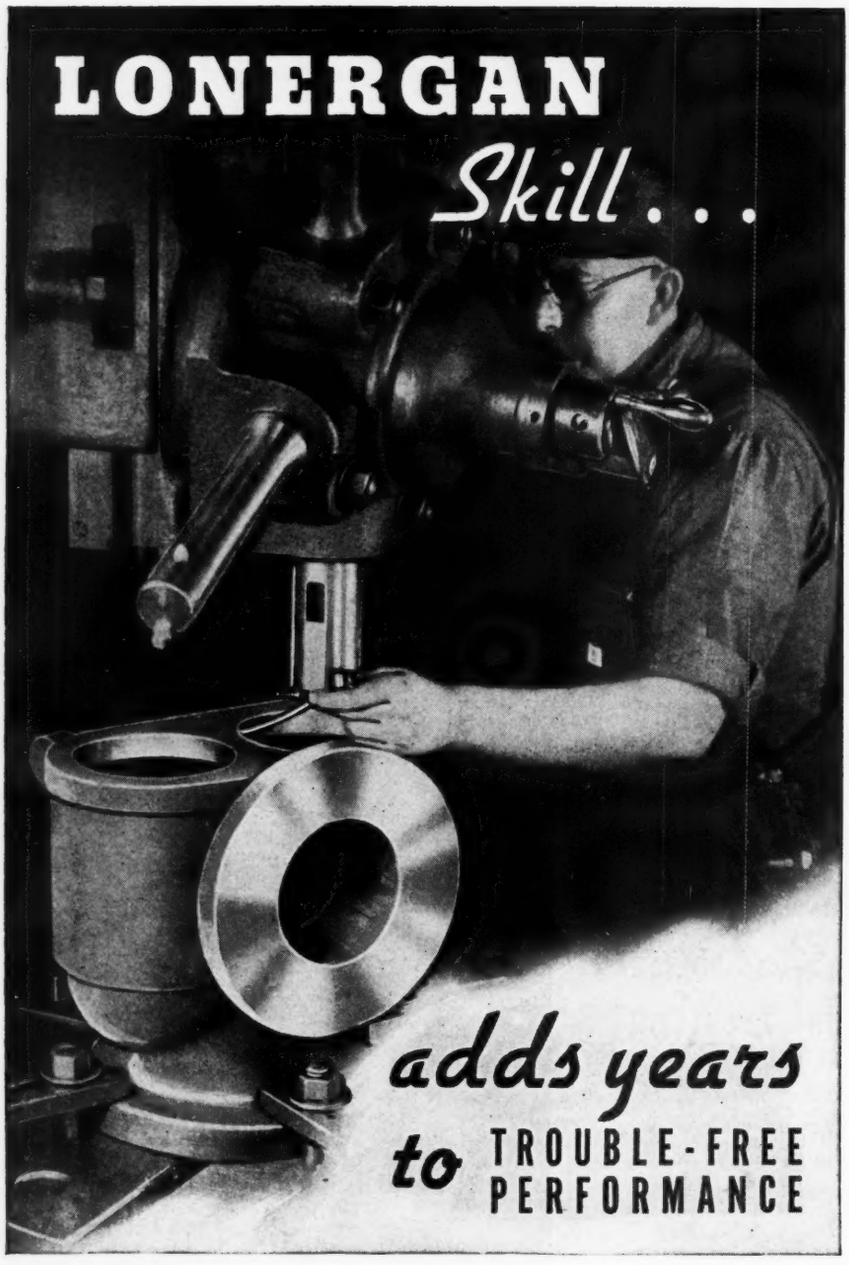
Showing how Pressure Seal is obtained. Internal pressure seals inner cover tightly. Split ring permits easy removal of sealing assembly. Bolts are used only to hold assembly in position until placed under pressure.

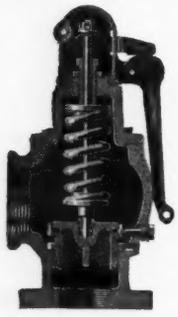
J-50135

WESTINGHOUSE ELECTRIC

Westinghouse *Complete* STEAM AND STOKER SERVICE

TURBINES · CONDENSERS · FEED WATER HEATERS · VACUUM EQUIPMENT · STOKERS





MODEL WT
POP SAFETY VALVE

A. S. M. E., Iron Body, Bronze Mounted. Designed particularly for Water Tube Boilers. Relieving capacity based on sustained lift of disc. Positive in action—opens and closes sharply.

For over half a century Lonergan Valves and Gauges have been noted for their accuracy and trouble-free operation, but no product can be better than the mechanical skill of the men who make it. Lonergan mechanics have been chosen for their natural ability. Acquired skill has come from long experience — each worker is happy in his appointed task.

Added to this accumulated skill is the fact that each Lonergan product is precision tested under actual service conditions. The result is an unsurpassed duration of trouble-free performance.

Specify Lonergan for long life. See your local distributor or write for new 1938 catalog.

J. E. LONERGAN CO.
Second and Race Streets, Philadelphia, Pa.
300 Specialties for Power Plants Standard Since 1872

Lonergan VALVES · GAUGES · SPECIALTIES ·

BRAIN TESTER

Answer to problem on page 104

No he didn't travel 6½ inches; only 2½ inches. Remember that the books are in order—Vols. 1, 2, and 3. The first page of Vol 1 would be separated from Vol. 2 only by the covers, equal to ¼ inch. The worm would then have to work through all the pages in the second volume (2 in.) and then through another set of covers making a total of 2½ inches. But then he would be through, for the last page of the last book would be next to the cover adjoining the middle book. The technically-minded worm didn't travel so far after all—it just seemed long!

---

fresh air was introduced, the remainder recirculated.

By using small units, and dividing the load, we had no difficulty in maintaining from 6 to 10 F below outside temperature with only manual control.

Nutley, N. J. THOMAS SHEEHAN

Several Simple Control Methods

FMA DOES not state the full conditions of his restaurant, but assume his place of business to be on one floor with no private dining rooms. In this case the preference would be for simple controls able to handle the lunch and dinner peaks as well as the lulls between.

Compressor capacity can be regulated by use of a 2-speed unit by an unloading bypass on the compressor, or by step controls to start compressors, if more than one machine is installed. These devices in conjunction with a manually-operated vortex on the fan or a variable-speed fan motor, have been quite successful in a number of restaurant installations.

Brooklyn, N. Y. FRANK RAPHAELIAN

STRAWS

(continued from page 96)

Broadmoor Hotel, Inc, Colorado Springs, contracted General Electric Co, for turbine-generator, transformers and motors for power house. Also let contract to Westinghouse Electric & Mfg Co, for condenser, switchboard and accessories; and for six electric elevators for hotel addition to Otis Elevator Co.

Craig plans municipal electric plant. Cost about $100,000. Bond issue being arranged. E T Archer & Co, New England Bldg, Kansas City, Mo., consulting engineers.

CONNECTICUT——New Haven Gas Light Co, New Haven, plans extensions in plant and system during 1938. About $130,000 has been authorized for work.

Armstrong Rubber Co, West Haven, plans boiler plant at new mill at Natchez, Miss., for manufacturing automobile tires for Sears, Roebuck & Co, Chicago, Ill., which will be active in financing and operating plant. Cost close to $2,000,000.

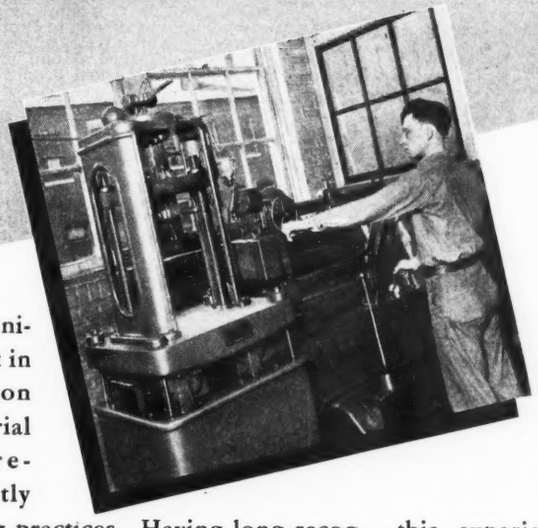
Greenwich Gas Co, Greenwich, plans improvements in gas plant and distributing system. $400,000 being arranged for work, scheduled to be carried out in 1938.

P.F.I.

THE PIPE FABRICATION INSTITUTE

Devoted to

THE TECHNICAL AND ECONOMIC PROBLEMS IN PIPING



Continuous technical development in steam generation and in industrial processing requires constantly changing piping practices. Having long recognized this condition, leading members of the Pipe Fabrication Institute make piping research and development a regular part of their business. These studies have solved innumerable piping problems regarding pressure welding, bending, lap jointing and forming, and the selection of suitable materials. The many benefits of this experience are always available to the user in securing piping that exactly suits the technical and economic requirements of his own particular job.

THE PIPE FABRICATION INSTITUTE

P.F.I. THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

1108 CLARK BUILDING • PITTSBURGH, PA.

Courtesy of Kinney Mfg. Co.

● prevents end-play

Adjustment of anti-friction bearings on this Kinney Pump is taken care of by Laminum shims. They fit on both shafts, in the ball thrust bearings, and fix the location of the "Heliquad" rotors endwise in the pump casing. Precision adjustment . . . merely by peeling off the .002 in. (or .003 in.) laminations! Write for Laminum sample.

LAMINATED SHIM CO., INC. 21-60 44th Avenue, Long Island City, New York

Cleveland Detroit Milwaukee

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LAMINUM

Precision adjustment **SHIMS**

W-S FORGED STEEL FITTINGS

For complete satisfaction on lines carrying oil, gas, steam, water or ammonia under high pressures and high temperatures, specify W-S Forged Steel Fittings.

They are bored from solid steel forgings, have sharp accurately cut threads and every fitting is carefully inspected and tested.

You will find them definitely stronger, longer lived and more dependable under the most severe conditions.

The better service insured by W-S Fittings is expressed in dollars saved in maintenance.

Write for Bulletin A-3.

THE WATSON-STILLMAN CO.
ROSELLE, N. J.

Assn, Bushnell, plans power plant near municipal limits for rural electric system. Cost about $34,000.

Burdine's, Inc, 22 E Flagler St, Miami, contracted Carrier Corp, for air-conditioning system in new multi-story commercial building. Entire project will cost about $1,000,000. Roy L Mann, general superintendent.

GEORGIA——Lowell Bleachery, Griffin, contracted Newton Coal & Lumber Co, Griffin, for 1-story building, 50 x 175 ft, to be equipped as a boiler plant. Cost over $65,000, with boiler units and accessories.

West Point plans motor-driven pumping machinery and auxiliary equipment, and new 100,000-gal. elevated steel tank and tower for water system. R L Totten, Atlanta, consulting engineer.

ILLINOIS——Frisina Theater Co, Springfield, plans central-heating plant in new motion-picture theater at Sixth and Main Streets, Vincennes, Ind. Cost about $150,000. C T Meyer, Springfield, architect.

Geneva plans municipal electric plant and will take bids soon for equipment. Wells Engrg Co, Geneva, consulting engineer.

INDIANA——Citizens' Gas & Coke Utility, 47 South Penn Ave, Indianapolis, plans extensions in artificial-gas plants and distributing system during 1938. $200,000 authorized.

Odon plans motor-driven, deep-well pumping machinery in new pumping station. Also will purchase 60,000-gal. elevated steel tank and tower. $60,000 arranged for entire project. Lennox & Mathews, Architects' and Builders' Bldg, Indianapolis, consulting engineers.

Board of School Trustees, Evansville, plans boiler house at new vocational school. Entire project will cost about $250,000. Fowler & Legeman, Central Union Bank Bldg, Evansville, architects.

Morrocco plans water-softening plant, including pumping station. Cost about $35,000. Bond issue being arranged. Suhr, Berryman, Peterson & Suhr, 130 N Wells St, Chicago, consulting engineers.

St. Mary's R C Parish, Huntington, care of R C Lennox and J C Matthews, Architects' and Builders' Bldg, Indianapolis, architects, plans central heating plant for cathedral and parochial school. Bids will be asked soon.

IOWA——West Liberty plans addition to municipal power plant. Purchase of diesel authorized for increased capacity. Cost estimated close to $45,000.

Oakland plans municipal electric plant. Estimates of cost are being made. Proposed to arrange special election for bond issue at early date.

Maquoketa contracted American Locomotive Co, Auburn, N. Y., for diesel generator unit and cooling system for municipal power plant at $65,464. Also let contract to Electrical Engrg & Const Co, Des Moines, for switchboard at $9,804.

Allerton plans water-treatment plant for municipal water system. Also, new elevated steel tank and tower. Cost about $50,000. Hall Engrg Co, Centerville, consulting engineer.

Key City Gas Co, 669 Main St, Dubuque, plans extensions in coal-gas generating plant on Eleventh St, including new equipment. Cost about $75,000.

State Board of Education, Des Moines, contracted American Engineering Co, at $134,465 for steam-generating unit and auxiliaries for power house at Iowa State College of Agriculture and Mechanic Arts, Ames.

KANSAS——Stafford contracted Stamey & Tidd Co, 10 W 21st St, Hutchinson, for improvements in municipal power plant, including 450-hp diesel-generator unit and auxiliaries.

Plainville plans municipal electric plant, including electrical distributing system. Cost about $100,000. Bond issue being arranged. A W Hefling, 200 N Main St, Hutchinson, consulting engineer.

Randolph has authorized surveys and estimates of cost for a municipal electric plant. Diesel generator units are planned. Paulette & Wilson, 1006 Kansas Ave, Topeka, and Farmers' Union Bldg, Salina, consulting engineers.

YOU CAN WELD 1001 JOBS 15% FASTER WITH THE 6-IN-1 *"Shield-Arc"*

THE JOB SELECTOR of a Lincoln *"Shield-Arc"* Welder enables you to lower costs by having your pick of any TYPE of arc. It gives you selectivity and range equal to 6 special welders. You can get an arc that is especially designed for overhead or vertical work, one for high-speed, deep-groove welding, one for delicate tool welding, one for sheet metal, one for alloys, etc. In fact, you can get an arc of *any* characteristics you need to do the best welding possible on all classes of work. And at each setting of the Job Selector, you can get any SIZE of arc with *"Shield-Arc's"* Current Control for any one of 1001 welding jobs.

Users of the 6-in-1 *"Shield-Arc"* report that its selectivity and range increases welding speed, improves weld quality and lowers costs as much as 15%. Mail the coupon for a free copy of a booklet which gives complete details.

LINCOLN

LARGEST MANUFACTURERS OF ARC WELDING EQUIPMENT IN THE WORLD

THE LINCOLN ELECTRIC CO., Dept. U-485, Cleveland, O.

Send a free copy of the book explaining how I can lower welding costs with the *"Shield-Arc"* Welder.

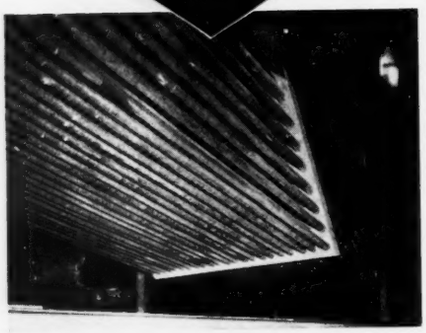
Name _____ Position _____

Company _____

Address _____

City _____ State _____

BECO-TURNER Baffles for LOW-HEAD BOILERS



Beco-Turner cross baffles in connection with 451 hp. Erie City boiler at Tennessee State Prison, Nashville, Tenn.

BECO-TURNER baffles are particularly suitable for low-head boilers. As shown above, it is our standard practice in connection with this type of boiler to install cross baffles which give cross flow of the gases across the tubes, instead of parallel flow. Cross baffles raise both efficiency and capacity.

Beco-Turner designs are not confined to those that can be constructed with a limited number of tile shapes. Beco-Turner baffles are constructed of "castable," or self-hardening, refractory material. Consequently, they can be installed at any angle and in any design that gives the greatest heat-absorbing efficiency.

If you contemplate the installation of low-head boilers, we shall be pleased to submit our recommendations for the baffles. If you are already operating boilers of this type, we shall be glad to suggest any possible improvements in baffle design.

This service is offered without charge or obligation. Just send us your blueprints showing your boilers. Or mail coupon below for your copy of the valuable Beco-Turner catalog covering all principal types of water tube boilers.

Plibrico Jointless Firebrick Co.

Nation-Wide Boiler Setting Service

Baffle Dept., Chicago, Ill.

MAIL COUPON FOR FREE CATALOG

Plibrico Jointless Firebrick Co. P5-38
1818 Kingsbury St., Chicago, Ill.
Please mail copy of Beco-Turner catalog

Firm .....

Address .....

Name ..... Title .....

.....

Kansas Electric Power Co started excavation work in February for 10,000-kw steam plant, the first unit of which will cost approximately $1,000,000. The plant is being constructed to fit into a triangular system between Lawrence, Leavenworth and Emporia.

KENTUCKY——Corbin plans extensions in municipal electric plant, including additional equipment. Surveys and estimates being made by Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo., consulting engineer.

Old Kennebec Distilling Co, Frankfort, plans 1-story boiler house and new mechanical-drying building, to replace units recently destroyed by fire. Loss estimated at $200,000, including damage to main distillery.

Central City takes bids soon for municipal filtration plant, including elevated steel storage tank and tower, meters and auxiliary equipment. Westcott & Thornton, Cary Bldg, Owensboro, consulting engineers.

Owensboro is having plans drawn by Black & Veatch, 4706 Broadway, Kansas City, Mo., for extensions in municipal power plant, including additional equipment. Cost about $27,000.

J Aron & Co, 416 Poydras St, New Orleans, plans power house in connection with rebuilding of cane-sugar mill near Napoleonville, recently destroyed by fire. Loss close to $500,000.

LOUISIANA——Ville Platte plans municipal power plant. Surveys and estimates of cost will be made by F P Joseph, Glenmore, consulting engineer.

Jeanerette has preliminary plans for new municipal electric plant. Also considering municipal pipeline system for natural-gas distribution. Estimates of cost are being made.

Beaux Bridge Sugar Cooperative, Inc, Beaux Bridge, plans power house at proposed local cane-sugar mill. Stanley Angello, Jr, secretary and treasurer.

Sunset plans pipeline system for natural-gas distribution in part of St. Landry Parish. Permission has been granted and work will begin soon.

MARYLAND——Southern Maryland Tri-County Cooperative Assn, Welcome, W M Reed, president, contracted Lewis Electric Co, Bedford, Ind., for power plant and substation for rural electric system, at $49,820.

Phillips Canning Co, Cambridge, plans boiler house at new vegetable-canning plant at or near Miami, Fla., where site is being acquired. Cost over $70,000.

MASSACHUSETTS —— Rockport plans pumping plant with motor-driven pumping units, and filtration plant for new water-supply source at Cape Pond. Cost about $485,000. Metcalf & Eddy, Statler Bldg, Boston, consulting engineers.

Springfield plans series of three large motor-driven pumping stations for municipal sewage system. Cost over $1,000,000. Metcalf & Eddy, Statler Bldg, Boston, consulting engineers.

MICHIGAN——Michigan Children's Village, Coldwater, plans central heating plant in group of new additions at institution. Cost about $750,000. Stewart-Kingscott Co, Kalamazoo, architect.

Lansing plans water-softening and treating plant for municipal water system. Cost about $500,000. Samuel Jacka, city engineer.

Menominee plans municipal electric plant and has authorized immediate purchase of site. Cost about $800,000; bond issue of $623,000 has been arranged, remainder of fund to be secured through Federal aid. Francis Engrg Co, Saginaw, consulting engineer.

Charlevoix plans municipal power plant. Bids are scheduled to be asked soon. Cost about $200,000. Financing being arranged through bond issue. Hamilton & Weeber, Grand Rapids, consulting engineers.

Clareco Gas Co, Mount Pleasant, plans welded-steel pipeline from natural-gas properties in Wise Township, Isabella County, Mich., to connection with main pipeline of Gas Corp of Michigan, Inc, Mount Pleasant. Permission has been secured and work will begin soon.

MINNESOTA —— Morgan Co-operative

GLASS COMPANY SAVES $1800

by forestalling insulation failure

BECAUSE faulty insulation can tie up the plant in short order, this company makes periodic "Megger" insulation tests on all of its important electrical equipment. Recently a drop in "Megger" readings was observed in one of their large generators. Inspection showed that a serious condition existed, and enabled them to forestall a failure that would have cost at least $4,000 including loss of time and material. Accordingly, the machine was taken out of service and reinsulated at a cost of $2,200. Net saving—$1,800.

It is savings such as this which make engineers in every industry *believe* in the simple practice of periodic "Megger" testing, that gives them a constant check on the condition of insulation.

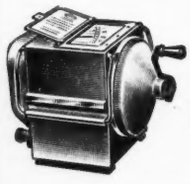
Management which considers electrical insulation failure an "act of Providence" would doubtless never think of *not* carrying fire insurance.

"Megger" testing is your insurance against insulation failure. Write for descriptive "Megger" Catalog 1550-P.

JAMES G. BIDDLE CO.

ELECTRICAL INSTRUMENTS

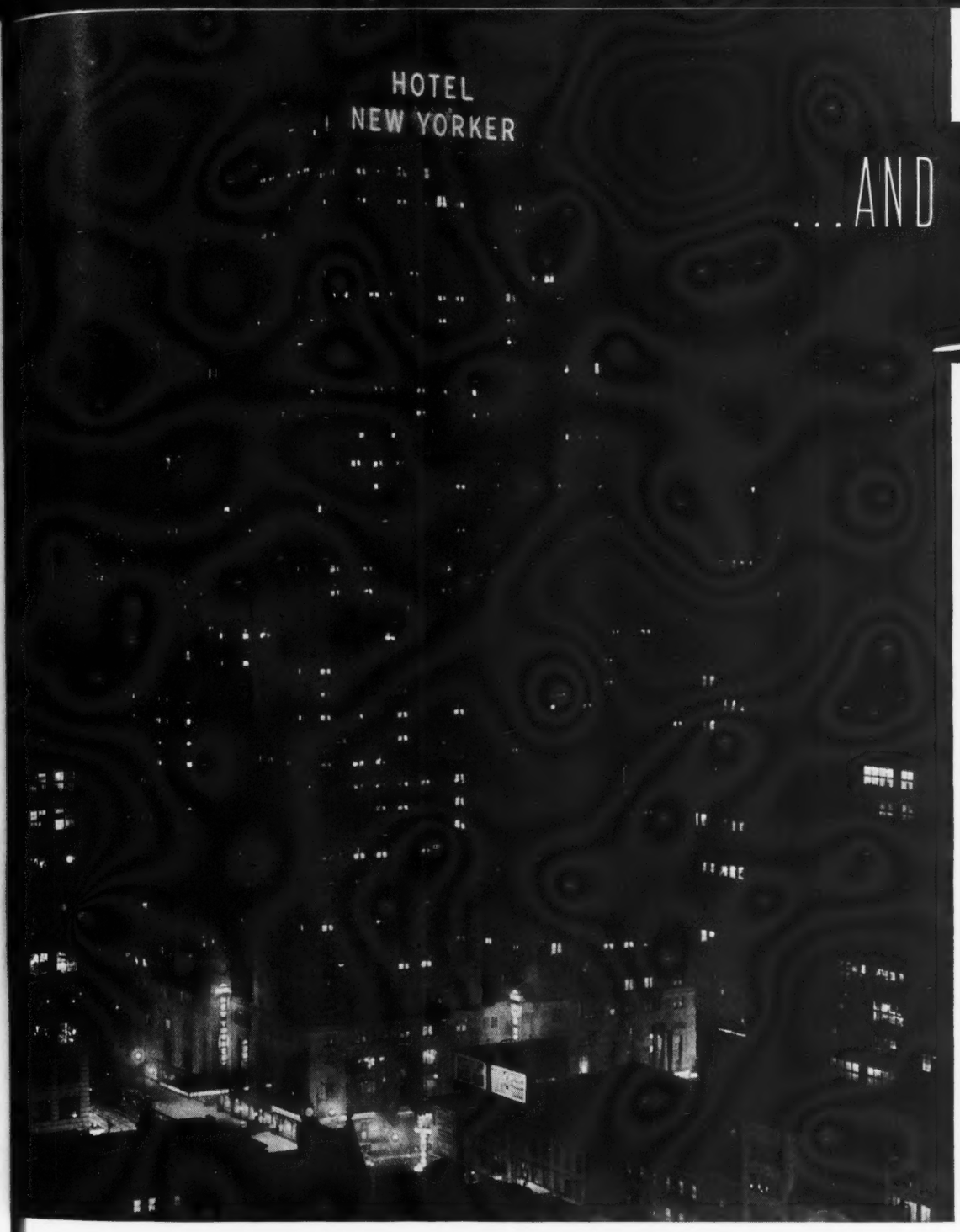
1211-13 ARCH STREET PHILADELPHIA, PA.



Popular type of "Megger" instrument known as "Meg" Insulation Tester. 500-Volts, 100-Megohms.

"MEGGER"

TRADE MARK REGISTERED U.S. PAT. OFF.



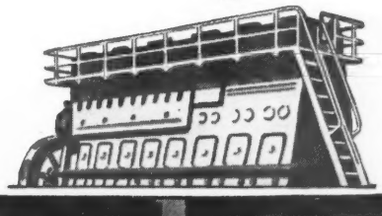
...AND THERE WAS *Light*

Down in the sub-basement of this prominent and popular mid-town hotel in New York there's a De LaVergne Diesel Engine. Here again is another type of service for which these quiet, economical and dependable prime-movers are recommended. In industrial plants and utilities, for dredging, for pumping purposes in oil transportation and other services De LaVergne Diesels have established operating records that should interest every user of power. Facts and figures are available for the asking.

DE LA VERGNE ENGINE CO., PHILADELPHIA

Sales Agent for Baldwin-Southwark Corp.
Subsidiary of The Baldwin Locomotive Works

Pacific Coast Representative: **THE PELTON WATER WHEEL CO., San Francisco**



DE LA VERGNE diesel engines

AMBEST
METALLIC PACKING

SPARE the PACKING and SPOIL THE ROD
or
TRY AMBEST

AMBEST in Ring form — available in any size.

AMBEST in loose Strand form—to suit any size rod or box.

AMBEST in Spiral form —made in sizes ⅛ to 2" inclusive.

AMBEST is good to the last stroke of any good rod — the universal packing for all conditions of pressures and temperatures up to 600 degrees. Get longer service out of good rods by using AMBEST on engines, pumps, compressors, (both ends) throttle and valve stems, condenser tubes, etc.

AMBEST protects as it packs. It will not fuse or become hard. It is available for all packing requirements — in loose strand, spiral and ring forms. Because of its ease of application, AMBEST will save you both time and money.

EUREKA PACKING CO.
294-296 46th Street, Brooklyn, New York

A Genuine Briar Root Pipe Sent Free with an order for Five Pound can.

For a limited period of time we will send you — ABSOLUTELY FREE — a cool smoking, BRIAR PIPE with every order for a five pound can of AMBEST. Use coupon below in accepting this offer.

USE COUPON BELOW

EUREKA PACKING COMPANY
294-296 46th St., Brooklyn, N. Y.

Gentlemen: Kindly ship us a five pound can of AMBEST in strand form at $1.50 per pound F.O.B. Factory, and include without charge a genuine Briar Root Pipe.

Name.....

Address.....

Company.....

Creamery, Morgan, is considering refrigerating plant with locker facilities. Cost over $35,000, with equipment.

Warroad Co-operative Creamery, Warroad, plans cold storage and refrigerating plant, with locker facilities. Financing being arranged. Cost about $30,000.

Virginia plans extensions in municipal steam-heating distribution system, including pipelines and operating facilities. Financing through Federal aid.

R E Stoyke, Stewartville, heads project to construct and operate local cold-storage and refrigerating plant, with locker facilities. Cost about $35,000.

Clyde Stephen, Luverne, plans addition to ment plant, to be equipped as a cold-storage and refrigerating unit, with locker facilities. Cost close to $30,000, with equipment.

Madison plans improvements in municipal power plant, including generator and accessories, water softener and other equipment. Perkins & McWayne, Paulton Block, Sioux Falls, Iowa, consulting engineers.

Jasper Cooperative Creamery, Jasper, plans 1-story cold-storage plant with locker facilities. Cost about $30,000, with equipment.

Eveleth plans municipal electric plant. Cost about $850,000, of which $260,000 will be secured through Federal grant. Hugo Sholund, city engineer.

MISSOURI——Columbia contracted Springfield Boiler Co, for boiler and auxiliaries for Municipal power plant, at $90,918. Also let contract to Ingersoll-Rand Co, for two boiler-feed pumps and two circulating-water pumps, and to Schutte-Koerting Co, for feedwater heater.

St. Francis Hospital, Cape Girardeau, plans central-heating plant in connection with new 4-story addition to hospital. Cost about $175,000. R P Ranft, 3946 Keokuk St, St. Louis, architect.

Manhasset Village Corp, St. Louis, plans central-heating plant in new apartment house project on Eager Rd, consisting of group of multi-story units to cost about $2,000,000. Financing through Federal aid. R J Bradshaw, Inc, 718 Locust St, architect; M F Marks, 411 N 7th St, mechanical engineer.

NEBRASKA——Board of Scottsbluff County Commissioners, Gering, contracted North Central Gas Co, Gering, for installation of new boiler unit and auxiliary equipment in power house.

Alliance contracted Stearns-Rogers Mfg Co, Denver, Colo., for boiler unit, superheater and economizer for municipal power plant at $32,000. Also made award to Republic Flow Meters Co, Chicago, Ill., for combustion control equipment. Contracts had been let previously to General Electric Co, for turbine-generator at $56,635, and to Elliott Co, Pittsburgh, Pa., for surface condenser at $14,158. Further awards will be made in near future. Entire project will cost about $240,000. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

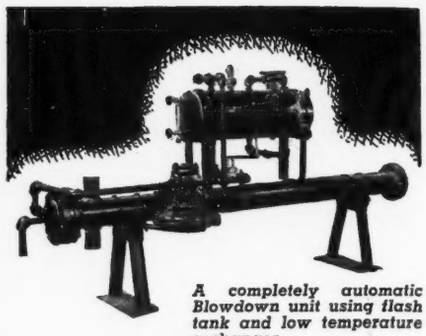
Blair contracted Busch-Sulzer Bros Diesel Engine Co, St. Louis, Mo., for 500-kw engine-generator unit for municipal power plant, at $47,559. Extensions and improvements will be made in plant, and other contracts will be placed soon. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

State Board of Control, Lincoln, will take bids soon for power house at state hospital at Kearney. $45,000 has been authorized.

Wymore Ice & Storage Co, Wymore, plans ice-manufacturing and refrigerating plant at Lincoln. Cost close to $40,000, with equipment. M L Rawlings is head.

With most of superstructure steel in place, walls are being erected for Nebraska Power & Lt Co's new $1,200,000 steam-electric plant and 28th & O Sts, Omaha. When completed about June 1, the plant, to have two 400,000-lb-per-hr boilers, will furnish steam and power (6000-kw turbine-generator) to Omaha south side packing plants.

NEW HAMPSHIRE——Berlin has authorized surveys and estimates of cost for new municipal electric plant. Also for a distributing system. Burns & McDonnell Engrg Co, 107 West Linwood Blvd, Kansas City, Mo., consulting engineer.



A completely automatic Blowdown unit using flash tank and low temperature exchanger.

● **To those who are responsible for the smooth, unfailing operation of one or more boilers, let us make this statement.**

The Henszey Company manufactures *all methods* of controlling boiler water concentration — the most popular being the Henszey Continuous Blowdown System. Popular because it offers complete automatic blowdown *without heat loss.*

Let Henszey Engineers design the most practical and the most economical method of boiler water control for the particular circumstances that surround your individual problem. A coupon is attached for your convenience—fill it in for complete information.

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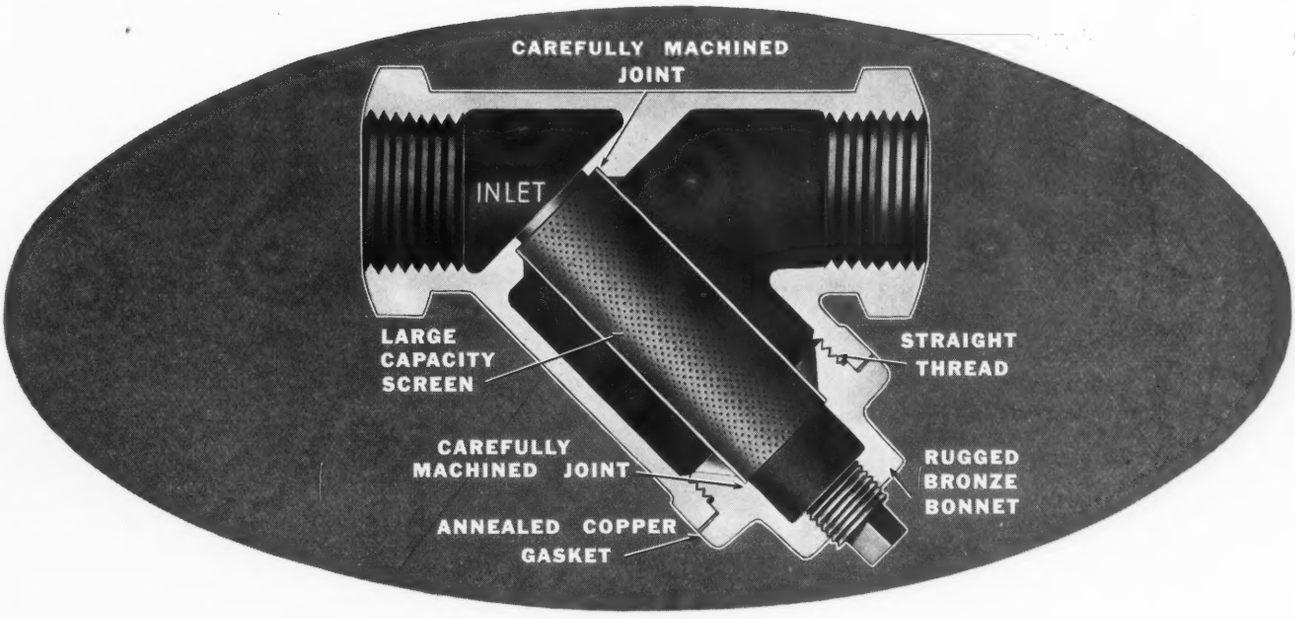


USE QUALITY STRAINERS TO PROTECT THESE VITAL POINTS

Minutes lost cost you money when regulator, valve or pump goes out of service due to scale, bits of packing, sediment, or other foreign matter lodging in the mechanism. Every engineer knows from experience the insurance value of pipe strainers. The wise engineer makes doubly sure of uninterrupted service by specifying Masoneilan strainers—a quality product with exclusive valuable features. Check these advantages before you buy *any* strainer:

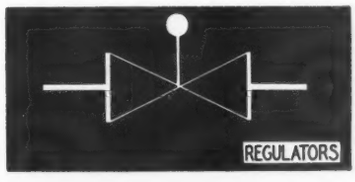
Rugged Construction—bronze bodies in small sizes (¼″ to 1½″), fitted with heavy bronze bonnets and pipe plugs for blow-off. Iron bodies in sizes 2″ to 4″, with flanged iron bonnets and pipe plugs.

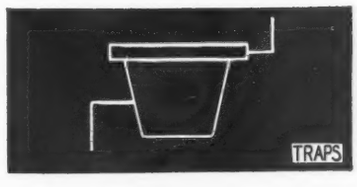
Precision Built—bodies and bonnets are carefully machined to assure uniform tight jointing at top *and bottom* of screen, no matter how often screen is removed for thorough cleaning. No leakage or buckling of the screen is possible. Gaskets facilitate removal of bonnet for cleaning screen.

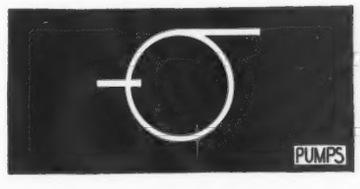
Convenient—screen may be cleaned without removing strainer from the line.

Efficient—brass screens with small perforations, (.02″ diameter) retain all but the smallest sediment. Large free area of screen assures no reduction in volume of flow even when screen is half full.

Be safe by using strainers at every vital point. Be *doubly* safe by specifying Masoneilan Strainers. Your mill supply distributor carries them in stock—or can get them quickly. Ask him for Bulletin No. 67. Or write our nearest office.







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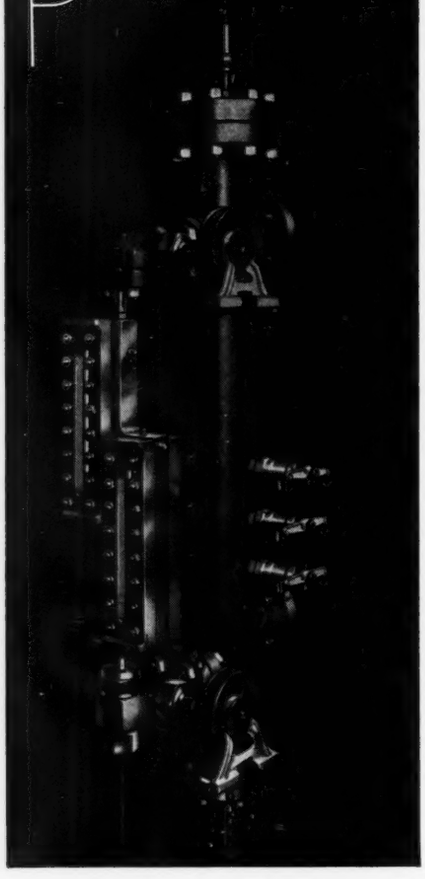

Yarway's unique Hi-Lo Alarm mechanism utilizes balanced *solid weights* that are as indestructible and unchanging as the metal itself. Operating on the displacement principle, they literally "weigh the water level."

When the high or low water emergency occurs—instant, positive, powerful, hair-trigger *action* results—giving warning of danger by whistle, light, or both.

Yarway Water Columns, eight standard models, iron bodies with screwed connections for pressures up to 250 lbs., forged steel bodies with flanged connections for pressures up to 1500 lbs., are fully described in Catalog WG-1806. Write for a copy and working model.

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YARWAY
FLOATLESS HI-LO ALARM
WATER COLUMN

NEW YORK——Quartermaster, Army Base, Brooklyn, contracted Westinghouse Electric & Mfg Co for one 150-kw generator unit and auxiliary equipment for local yard, at $13,000.

Board of Education, Greigsville, plans central-heating plant at new multi-story central school. Cost about $400,000. Harbach & Kideney, 505 Franklin St, Buffalo, architects.

Jamestown, plans municipal gas plant and distribution system. Bids are scheduled to be asked soon. Cost about $1,200,000.

Yonkers Light & Power Co will add 30,000-kw capacity this fall, and are now rewinding a 20,000-kw, 25-cycle unit into a 60-cycle machine.

NORTH CAROLINA——Asheville plans central-heating plant in new municipal auditorium and convention hall. Cost about $180,000. L M Gudger, 52 Carter St, Asheville, architect.

Four-County Rural Electric Membership Corp, Kerr, plans electric-generating plant on local site. Cost close to $50,000. Financing through Federal aid.

White Ice Cream Co, Princess St, Wilmington, will install ice-manufacturing and refrigerating machinery in new local plant. Cost about $50,000. Work scheduled to begin soon.

Charlotte Fish & Oyster Co, 302 Trade St, Charlotte, plans 1-story addition to ice and cold-storage plant. Cost over $50,000 with equipment. G Rogers, 103 S Tryon St, Charlotte, architect.

NORTH DAKOTA——Eddy County Roller Mill, New Rockford, plans boiler house in connection with rebuilding of portion of grain and flour mill, recently destroyed by fire. Loss about $30,000.

Williston plans municipal power plant for waterworks pumping station and street-lighting system. Estimates of cost are being made.

OHIO——Ohio Ice Cream Co, Hamilton, plans ice and refrigeration plant in new 1-story factory on Leslie Ave, Norwood, Cincinnati. Cost about $40,000.

American Rolling Mill Co, Middletown, contracted Babcock & Wilcox Co for five watertube boilers for branch steel works at Ashland, Ky, replacing a battery of old boilers

Lorain plans motor-driven pumping machinery in water station Cost about $25,000. Also will install 1,500,000-gal. elevated steel tank on steel tower, to cost about $110,000. C A Pauly, chief engineer, in charge.

Standard Oil Co of Ohio, Midland Bldg, Cleveland, contracted L A Wells Co, Schofield Bldg, Cleveland, for construction of four 6-in. and one 8-in. pipelines across Cayahoga River at foot of South Clark St, for oil and gasoline transmission.

Crowell Publishing Co, Springfield, contracted Refrigeration Equipment Co, Dayton, for air-conditioning plant and system in printing plant. Cost about $40,000.

OKLAHOMA——Fairview plans improvements in municipal power plant, including 700-hp diesel-generator unit and auxiliary equipment. Cost about $60,000. A special election to vote bond issue being arranged. E A Evans, engineer.

Chilocco Indian School, Chilocco, plans steam power house at institution for central-heating system. Cost about $175,000.

Fairfax contracted Fairbanks-Morse & Co, for 60-hp diesel engine and one 350-gpm, pumping unit, with auxiliary equipment for municipal waterworks station.

Continental Oil Co, Ponca City, plans compressors, boilers, pumps and other equipment in new natural-gas plant in K-M-A oil field area, Wichita County, Tex. Welded-steel pipeline will be built for natural-gas transmission to plant, which will have a capacity for handling 15,000,000 cu ft daily. Cost over $100,000.

Terminal Cotton Oil Co, 5 E Frisco Ave. Oklahoma City, plans boiler house in connection with rebuilding of portion of cottonseed oil mill, recently destroyed by fire. Loss close to $100,000.

English Ice Mfg Co, Shawnee, contracted Jacobs & Son, 1403 N Harvard St, Tulsa, for general erection of 1-story and basement ice-manufacturing plant on N Denver St, Tulsa. Cost about $45,000, with equipment.

OREGON——Hollenbeck Brothers, The Dalles, plan cold storage and freezing plant, about 60 x 100 ft, on waterfront, for handling fish products. Cost close to $45,000, with equipment.

Lower Columbia Dairy Assn, Astoria, plans addition to plant at Clatskanie, Ore., to be equipped as cold-storage and refrigerating unit, with locker facilities.

TENNESSEE——Murfreesboro plans cold-storage and refrigeration plant to be operated as a cooperative enterprise. Cost over $30,000, with equipment. Ellis Ransom, chairman of committee in charge.

Mississippi Valley Hardwood Co, Memphis, is considering new boiler house in connection with rebuilding of portion of mill recently destroyed by fire. Loss about $100,000.

TEXAS——Hotel Beaumont, Beaumont, plans air-conditioning system in 11-story hotel building, capacity of about 250 tons. Cost close to $100,000. Leo S Weil and Walter B Moses, 427 South Peters St, New Orleans, La., consulting engineers.

Madisonville plans early purchase of equipment for municipal butane-gas plant and distributing system. Bond issue of $45,000 has been authorized for project.

Lancaster plans municipal power plant and proposes to take bids soon for equipment. About $75,000 being arranged.

Pleasanton contracted Pittsburgh-Des Moines Steel Co, Pittsburgh, Pa., for elevated steel tank and tower for municipal water system at $41,000. Garrett Engrg Co, Houston, consulting engineer.

Hempstead is considering municipal power plant. Estimates of cost will be made soon. Special Utility Committee, L B Sanders, chairman, in charge.

Mammoth Producing & Refining Co, Corpus Christi, plans power house at proposed local oil refining plant. Entire project will cost about $250,000.

Corpus Christi plans extensions in municipal gas-distribution system. $21,875 arranged through Federal aid. Bids will be asked soon.

Hempstead is arranging bond issue of $90,000 for municipal power plant. Also a bond issue of $60,000 for extensions in water system, including pumping machinery and auxiliaries. Proposed to place orders for equipment soon.

Robstown will ask bids early in May for municipal electric plant to cost about $275,000. Also for municipal gas-distribution system to cost $75,000. Financing has been arranged. Garrett Engineering Co, Houston, consulting engineer.

Llano plans municipal gas-distributing system, including pipeline, control station and other operating facilities. Cost about $100,000. Rody & Clouse, Fort Worth, consulting engineers.

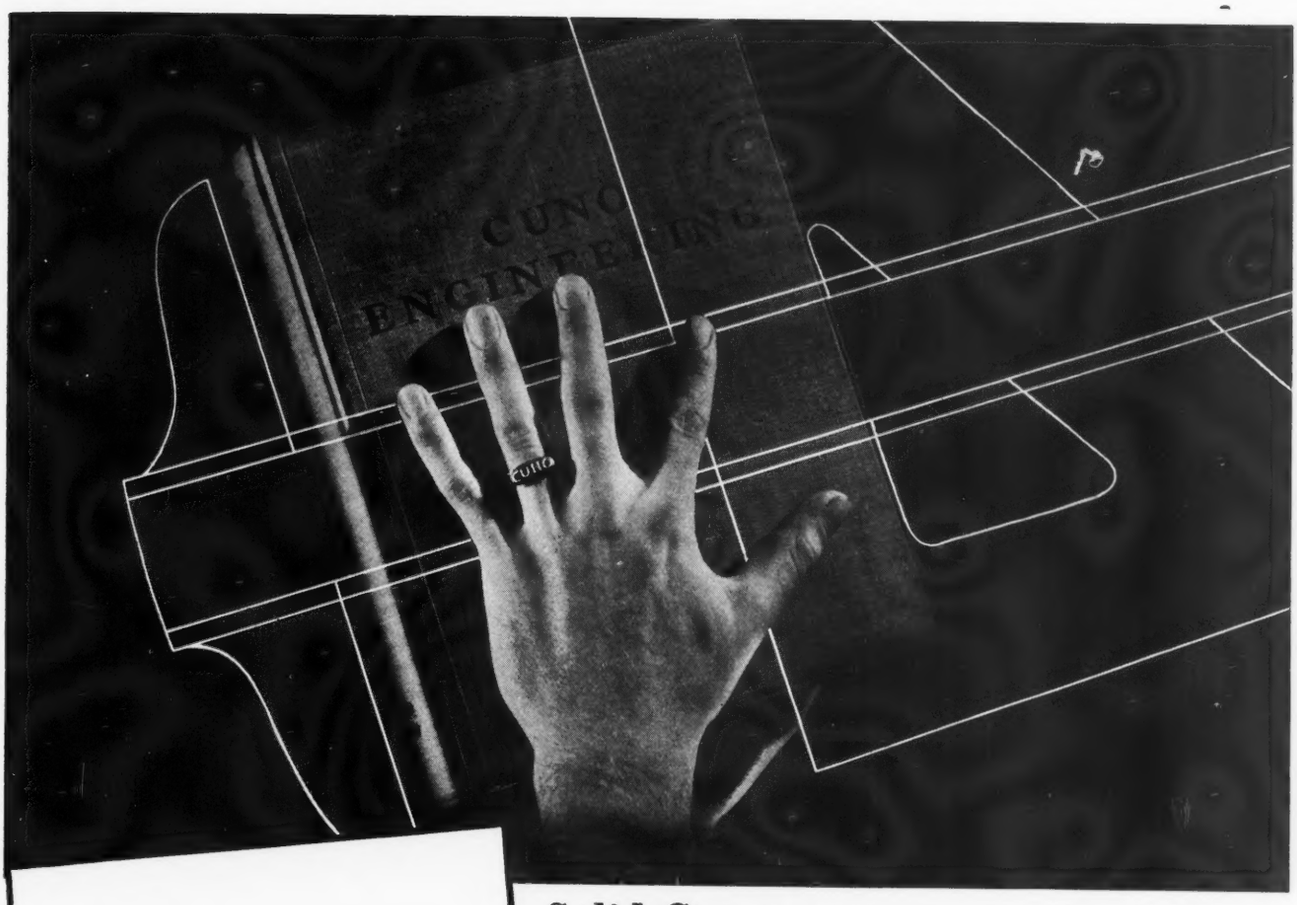
UTAH——Inland Empire Refineries, Inc, McIntyre Bldg, Salt Lake City, W H McIntyre, president, plans power house at new oil-refining plant at Spokane, Wash. Also will install pumping station and large steel tank storage division. Cost over $400,000. Ende Kaye, company engineer.

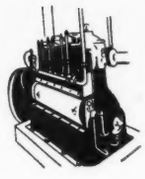
VIRGINIA——John F Sheppard, 3000 Kensington Ave, Richmond, plans ice and refrigerating equipment in new one-story ice cream plant. Cost about $35,000.

Norton is considering municipal electric plant, including distributing system. Cost about $150,000. Proposed to arrange bond issue in that amount. Roy P Bishop, town manager.

WASHINGTON——Pasco plans early purchase of two elevated steel tanks, 400,000- and 300,000-gal. capacity, for water system. Baar & Cunningham, Spalding Bldg, Portland, Ore., consulting engineers.

United Dressed Meats, Inc, 116 N Havana St, Spokane, plans boiler house in connection with new meat-processing and packing plant. Cost over $50,000. Colin G McDonald, general manager.





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Instruments and controllers die young unless efficiently protected. With Cuno — they can function uninterruptedly over a longer period of time. Wise powermen are specifying Cuno with their orders.

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Cuno's types of continuously cleanable filters — Auto-Klean and Flo-Klean have many sizes, strain two or three gallons per minute — or many thousand gallons. Made in any corrosion-resistant machinable metal, they operate over wide ranges of temperature, viscosity, and pressure; and they are all adaptable to special jobs. Our engineering service and laboratories are at your disposal, of course.

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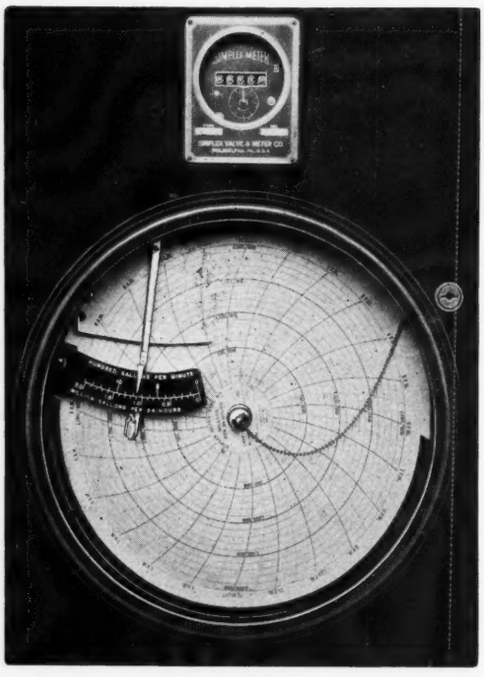

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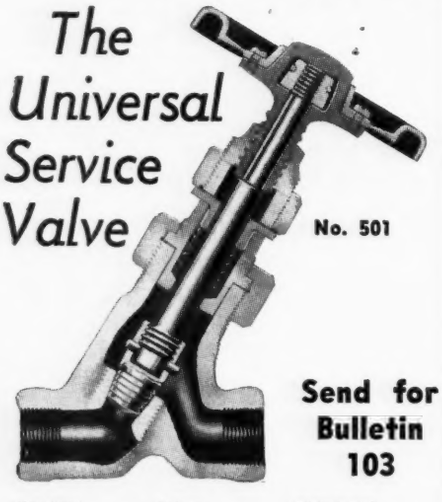

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Engineers' Books

Diesels

DIESEL OPERATOR'S GUIDE AND DATA BOOK (1937-1938 Edition)—*L H Morrison, Editor. Published by Diesel Power & Diesel Transportation, 192 Lexington Ave, New York, N. Y. Over 300 text pages, illustrated. Price $6.00 for de luxe edition, $5.00 for standard edition.*

Feeling that the principles of the diesel engine and general data on its performance and application have been covered in other texts, the editor of this book has passed over this material to devote more space to the practical operation and care of specific types of engines. Thus, each chapter is given over to a single make of engine, and each covers such items as clearances required, alignment, valve setting, etc. It should make a valuable addition to the diesel operator's library.

BRIEF REVIEWS

1937 RATE SERIES. *Published by Federal Power Commission, Bureau of Engineering. For sale by Supt of Documents, Washington, D. C. Price 15 cents*—50-page report shows in form of typical monthly net bills, rate charges as of Jan 1, 1937, to residential, commercial light, commercial power, and industrial consumers of electric energy in cities of 50,000 or more population.

SOLUTION OF ELECTRICAL NETWORKS BY SUCCESSIVE APPROXIMATIONS. *Published by Engineering Experiment Station, University of Illinois, Urbana, Ill. Price 45 cents*—Description of method for solving electrical networks by successive approximation, based on premise that all currents are assumed to satisfy the condition that total flow into or out of each junction is zero.

1937 ASTM PROCEEDINGS. *Published in two parts by American Society for Testing Materials, 260 S Broad St, Philadelphia, Pa. Parts I and II can be purchased at $5.50 each in stiff paper cover; $6, cloth; $7, half-leather*—Part I contains committee reports with appended papers, and new and revised ASTM tentative standards. Part II gives all technical papers.

CHEMISTS & CONSULTING ENGINEERS (1938). *Published by Assn of Consulting Chemists and Chemical Engineers, Inc, 50 E 41st St, New York, N. Y. Available on request*—Lists, describes and classifies type of work members of this Assn are prepared to do.

STEAM POWER DEVELOPMENTS (1937). *By Charles W E Clarke, Consulting Engineer, United Engineers & Constructors, Inc, Philadelphia, Pa. Presumably available from U E & C on request*—A reprint paper presented before 33rd annual convention of Assn of Iron & Steel Engineers, covers boilers, turbines, auxiliaries, etc.